SCIENCE

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THE CLEVELAND MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE sixty-fourth meeting of the American Association for the Advancement of Science was held at Cleveland, Ohio, from December 30, 1912, to January 4, 1913, under the presidency of Dr. Edward Charles Pickering, director of the Astronomical Observatory of Harvard College, Cambridge, Mass.

The excellent arrangements made for the meetings, the good hotel and other public utilities of Cleveland, and unusually mild and pleasant weather through most of the week, combined to make the material environment one of the most agreeable experienced by the association. The number of members registered was 720, and in addition 150 from the affiliated societies; but as is well known this registration is always incomplete, especially in the case of members of affiliated societies who are not members of the American Association for the Advancement of Science. It is safe to say that the total in attendance must have exceeded 1,000.

The following societies, most of them affiliated with the American Association for the Advancement of Science, met in Cleveland at the same time:

Astronomical and Astrophysical Society of America,
American Mathematical Society,
American Physical Society,
American Society of Zoologists, Eastern and Central Branches,
American Association of Economic Entomologists,
Entomological Society of America,
American Nature Study Society,
School Garden Association of America,
American Microscopical Society,
Botanical Society of America,
American Phytopathological Society,
Botanists of the Central States,
Society for Horticultural Science,
American Association of Official Horticultural Inspectors,
Association of Official Seed Analysts,
American Psychological Association,
American Society of Biological Chemists,
American Society for Pharmacology and Experimental Therapeutics,
American Association of Anatomists,
American Physiological Society,
American Federation of Teachers of the Mathematical and Natural Sciences,
Society of the Sigma Xi,
American Society of Naturalists.

The opening general session held on the evening of Monday, December 30, in the ball room of the Hotel Statler was called to order by the retiring president, Dr. Chas. E. Bessey, who introduced the president-elect, Dr. Edward C. Pickering. Addresses of welcome were given by Mr. Newton D. Baker, mayor of Cleveland, Dr. Chas. F. Thwing, president of the Western Reserve University, and Dr. F. M. Comstock, acting president of the Case School of Applied Science. Responses were made by President Pickering. The address of Mayor Baker was especially noteworthy as embodying ideals for the future of Cleveland which aroused the heartiest appreciation in the minds of all his hearers. Perhaps the strongest assurance that Cleveland will ultimately reach the eminent position predicted by him is the fact that it already has the foresight to elect such men to its highest offices. The annual address was then delivered by the retiring president of the association, Dr. Charles Edward Bessey on "Some of the Next Steps in Botanical Science." It is printed in the issue of Science for January 3. The general session then adjourned and was followed by a reception to the members of the association and affiliated societies.

The annual addresses by retiring vice-presidents were made as follows:

Monday Afternoon

Vice-president Shimek, before the Section of Geology and Geography. Title: "Significance of the Pleistocene Mollusks."

Tuesday Afternoon

Vice-president Frost, before the Section of Mathematics and Astronomy. Title: "The Spectroscopic Determination of Stellar Velocities, Considered Practically."

Vice-president Nachtrieb, before the Section of Zoology. Title: "Section F—Is It Worth While?"

Vice-president Newcombe, before the Section of Botany. Title: "The Scope of State Natural History Surveys."

Vice-president Millikan, before the Section of Physics. Title: "Unitary Theories in Physics."

Wednesday Afternoon

Vice-president Porter, before the Section of Physiology and Experimental Medicine. Title: "On the Function of Individual Cells in Nerve Centers."

Vice-president Thorndike, before the Section of Education. Title: "Educational Diagnosis."

Vice-president Ladd, before the Section of Anthropology and Psychology. Title: "The Study of Man."

Thursday Afternoon

Vice-president Norton, before the Section of Social and Economic Science. Title: "Comparative Measurements of the Changing Cost of Living."

Other addresses worthy of especial note were the following:

On Tuesday evening, Dr. W. J. Humphreys, of the U. S. Weather Bureau, gave an illustrated lecture, complimentary to the members of the American Association for the Advancement of Science and the affiliated societies and to the residents of Cleveland and vicinity, on the subject of "Across the United States with the European Geographers."

On Monday afternoon, President Benjamin M. Davis, of the American Nature Study Society, gave an address entitled "A Summary of the Study of Agricultural Instruction in Rural Schools."

President A. B. Macallum, of the American Society of Biological Chemists, gave an address on Monday on "The Energy of Muscular Contraction; Thermodynamic or Chemodynamic."

Dr. Edward Lee Thorndike gave his address on Tuesday, as president of the American Psychological Association, on the subject of "Ideo-motor Action."

President W. T. Macoun, of the Society for Horticultural Science, also gave his address on Tuesday on the subject "The Relation of Climate to Horticulture."

On Wednesday evening, Dr. Philip P. Calvert, of the Entomological Society of America, gave a public address on the subject "An Entomologist in Costa Rica."

On Wednesday, President W. D. Hunter, of the Society of Economic Entomologists, gave an address on the subject "Insects and Human Diseases."

On Wednesday afternoon, President John A. Lomax, of the Folk-Lore Society, gave an address on "Stories of an African Prince."

On Wednesday evening, Professor W. D. Farlow gave the address of the retiring president on "A Comparison of the Present Conditions in Botany with those in the Early Seventies."

On Thursday evening, Dr. T. J. Headlee gave his annual address, as president of the American Association of Official Horticultural Inspectors, on the subject of "The Federal Plant Quarantine Law."

On Thursday evening, Professor Edwin G. Conklin gave the annual address as president of the American Society of Naturalists on "Heredity and Responsibility."

A number of symposiums and sessions devoted to matters of public interest were held by various sections and affiliated societies. Among these may be mentioned a symposium under the auspices of the American Society of Biological Chemists on "Some Recent Applications of Physical Chemistry in Biology."

A symposium under the auspices of the Botanical Society of America on "Permeability and Osmotic Pressure."

A symposium by the Phytopathological Society on "International Phytopathological Problems."

A symposium in charge of the American Society of Naturalists on "Adaptation."

The section on social and economic science held a symposium on some economic problems of current interest.

A general interest program on sound and sound waves was held under the auspices of Section B.

A general interest program devoted largely to broad educational problems, including a discussion of the National University was held under the auspices of Section L.

The council met daily. Among the chief matters of business transacted were the following:

Seventy-five new members were elected.

Two hundred and fifty-five members were elected fellows.

A report from the committee on policy was adopted, providing for the appointment of a committee of five to consider the future of Section C.

The amendment to the constitution, proposed last year, and providing for the establishment of "Section M. Agriculture," was adopted.

Amendments to the constitution were also proposed as follows, in order that they may be acted upon next year under the provisions of the constitution.

Article 22—Amend by omitting "*Mechanical and*" after the title "*D,*" so as to read; "*D—Engineering.*"

Article 22—After "Section M. Agriculture" add "*The council shall have power to create additional sections from time to time, and to discontinue, combine, or rearrange existing sections.*"

The financial report of the permanent secretary was read, accepted and ordered printed.

The council adopted the following resolutions, relating to the proposed meeting at San Francisco in 1915.

Resolved: that a committee be appointed for the proposed San Francisco meeting of the association in 1915, this committee to be known as "The Committee on the Pacific Coast Meeting."

The president later appointed on this committee the following:

Wm. Wallace Campbell, Sc.D., LL.D., director of the Lick Observatory, Mt. Hamilton, Cal., *chairman;* John Casper Branner, Ph.D., LL.D., professor of geology, Leland Stanford University; Wm. Alanson Bryan, president Pacific Scientific Institution, Honolulu; Henry Smith Carhart, Sc.D., LL.D., Pasadena, Cal.; Charles Lincoln Edwards, Ph.D., University of Southern California, Los Angeles, Cal.; Professor Wm. Trufont Foster, president of Reed College, Portland, Ore.; Geo. Ellery Hale, Sc.D., LL.D., director of the Mt. Wilson Observatory, Pasadena, Cal.; Mellen Woodman Haskell, Ph.D., professor of mathematics, University of California; Eugene Waldemar Hilgard, Ph.D., emeritus director of the College of Agriculture, University of California; Geo. Holmes Howison, LL.D., professor of philosophy, University of California; Oliver Peebles Jenkins, professor of physiology, Stanford University; David Starr Jordan, M.D., Ph.D., LL.D., president of Stanford University; Thos. Franklin Kane, Ph.D., president of the University of Washington; Lyman Vernon Kellogg, professor of entomology, Stanford University; Chas. Atwood Kofoid, Ph.D., professor of zoology, University of California; Alfred L. Kroeber, Ph.D., Affiliated Colleges, San Francisco, Cal.; Andrew Cowper Lawson, professor of geology and mineralogy, University of California; E. Percival Lewis, Ph.D., professor of physics, University of California; Jas. Harvey McBride, M.D., Pasadena, Cal.; Daniel Trembly McDougal, Ph.D., LL.D., Desert Botanical Laboratory, Tucson, Ariz.; Lillien J. Martin, professor of psychology, Stanford University; John Campbell Merriam, Ph.D., professor of paleontology, University of California; Agnes Claypool Moody, Ph.D., Berkeley, Cal.; John Muir, LL.D., Martinez, Cal.; Wm. Emerson Ritter, Ph.D., director of the Marine Biological Station, San Diego, Cal.; Harris Joseph Ryan, professor of electrical engineering, Stanford University; Fernando Sanford, professor of physics, Stanford University; William Albert Setchell, Ph.D., professor of botany, University of California; John M. Stillman, Ph.D., professor of chemistry, Stanford University; Benjamin Ide Wheeler, president of the University of California.

The committee on policy presented the following, which was adopted:

Resolved: that it be recommended that the council authorizes the committee on the Pacific Coast meeting proposed for 1915, to hold in the name of the association meetings of its members resident in that region, for the purpose of considering the relations of the association to the exposition in question, and if desirable, for the presentation of scientific programs. The expenses incurred shall be met from funds in the hands of the permanent secretary to such extent as may be approved by the committee on policy.

The following grant was allowed:

To the Concilium Bibliographicum . $200

A report of progress in the study of fish scales was received from Prof. Theo. D. A.

Cockerell to whom a grant of $75.00 had been made.

A report was received from Mr. Charles Peabody, delegate of the association to the XIV. Congress International d'Anthropologie et Archeologie Prehistorique, which was held in Geneva, September 9–14, 1912.

The council passed the following resolution on "Expert Testimony," presented jointly by Dr. M. G. Lloyd and Dr. J. A. Holmes:

Resolved: that a special committee of five be appointed by the president to collect and study data covering the practise in different countries relative to the employment of expert testimony in court procedure, and to cooperate in joint committee with representatives of other national organizations in studying this question with a view to submitting recommendation for new state and national legislation concerning the same;

That the permanent secretary of the association extend to other national organizations interested in this subject an invitation from this association to appoint a member on said joint committee, and to cooperate further with this association in taking such action relative to this matter as will best promote public interest;

That this social committee of five shall report both its findings and the findings of the joint committee, and also such action as may be taken by other organizations to the council of the American Association for the Advancement of Science at its meeting in January, 1914.

The council adopted the following, introduced by Professor H. B. Ward:

Resolved: That the council refer to the committee on policy the question of granting to secretaries of sections, the general secretary, and the secretary of the council, a mileage allowance in addition to the hotel allowance now made, and that the council empower the committee to take such action as may seem wise after investigation of the subject.

The following resolution, introduced by Dr. J. A. Holmes, was adopted by the council:

Resolved: that a special committee of five be appointed by the president to consider and report to the committee on policy a plan for the more rapid increase in the membership of the association.

That the committee on policy is hereby authorized to employ an associate secretary at a salary not to exceed $3,000 per annum, whose traveling expenses shall also be paid out of the treasury not to exceed $800 per annum and whose special duty it shall be to carry forward this extension work.

The committee on policy is hereby authorized to adopt, if necessary, such method as it may deem best for collecting additional funds for meeting such expenditure as may be needed.

The president later appointed on this committee the following: Messrs. J. A. Holmes, Chas. Baskerville, Hugh M. Smith, H. B. Ward, H. W. Springsteen.

The council adopted the following resolutions, introduced by Dr. J. McK. Cattell:

Resolved: that the council of the American Association for the Advancement of Science requests the educational institutions, government bureaus and other agencies engaged in scientific research to send one or more delegates to the annual convocation week meetings of the association and its affiliated societies, and that when possible the traveling expenses of the delegates be paid by the institutions which they represent.

Resolved: that a committee of three be appointed by the chair to draw up a list of institutions to which this resolution, together with a suitable letter, shall be sent by the permanent secretary.

The following were elected as members of the council to serve for three years: Messrs. J. McK. Cattell, J. M. Coulter and N. L. Britton.

At a meeting of the general committee held Thursday evening, January 2, invitations for future meetings were received from Atlanta, Philadelphia, Nashville, St. Louis, San Francisco, Leland Stanford, University of California, Portland, Seattle, Niagara Falls, Cincinnati, Columbus and Denver.

It was resolved to hold the next meeting in Atlanta, Georgia. It was further resolved to recommend to the next general committee that the meeting for 1914 be

held at Philadelphia, and that a summer meeting be held at San Francisco in 1915.

The following officers were elected for the coming year:

President: E. B. Wilson, Columbia University, New York.

Vice-Presidents:

Section A—Frank Schlesinger, Allegheny Observatory.

Section B—A. D. Cole, Ohio State University.

Section C—A. A. Noyes, Massachusetts Institute of Technology.

Section D—O. P. Hood, U. S. Bureau of Mines, Washington, D. C.

Section E—J. S. Diller, U. S. Geological Survey.

Section F—A. G. Mayer, Carnegie Institution of Washington.

Section G—H. C. Cowles, University of Chicago.

Section H—W. B. Pillsbury, University of Michigan.

Section L—P. P. Claxton, U. S. Commissioner of Education.

General Secretary: H. W. Springsteen, Western Reserve University.

Secretary of the Council: W. A. Worsham, Jr., University of Georgia.

Secretaries of Sections:

Section A—F. R. Moulton, University of Chicago.

Section D—A. H. Blanchard, Columbia University.

Section F—H. V. Neale, Knox College.

Section G—W. J. V. Osterhout, Harvard University.

Section H—George G. MacCurdy, Yale University.

Section L—S. A. Courtis, Detroit, Michigan.

Place of next meeting: Atlanta, Georgia.

Date of next meeting: Convocation Week, 1913–14.

At the general session, held Friday morning at Western Reserve University, the following resolutions were adopted:

Resolved: that the American Association for the Advancement of Science extend to the authorities of Western Reserve University and to those of the Case School of Applied Science, to the Board of Education and the Director of Public Schools, to the Mayor of Cleveland, to the local committee in charge of the arrangements for the third Cleveland meeting of the association, now about to close, and especially to the ladies' reception committee and to the authorities of the different industrial plants which have been opened to the inspection of members, the hearty thanks of the association for the admirable arrangements made, the excellent facilities offered, and the delightful courtesy and hospitality which have been extended by all and which have been highly instrumental in making this third Cleveland meeting one of the most successful which the association has held in recent years.

H. E. Summers,
General Secretary

HEREDITY AND RESPONSIBILITY[1]

One of the greatest and most far-reaching themes which has ever occupied the minds of men is the problem of development. Whether it be the development of a chicken from an egg, of a race or species from a preexisting one, or of the body, mind and institutions of man, this problem is everywhere much the same in fundamental principles, and knowledge gained in one of these fields must be of value in each of the others. Familiarity with development does not remove the real mystery which lies back of it, though it may make plain many of the processes concerned. The development of a human being, of a personality, from a germ cell seems to me the climax of all wonders, greater even than that involved in the evolution of a species or the making of a world.

We are all familiar with the historic attempts which have been made to solve this problem. The old doctrine of evolution, or preformation, solved it by practically denying development; the doctrine of epigenesis recognized development but did not explain it. The one found all organs and parts present in the germ, which needed merely to grow and unfold to bring them

[1] Presidential address before the American Society of Naturalists, Cleveland, O., January 2, 1913.

to maturity; the other found the germ simple and homogeneous, but required some unknown force, some *spiritus rector* or *vis essentialis,* to cause the homogeneous to become heterogeneous. The one placed all emphasis upon the germ, the other upon outside forces or conditions.

Modern students of development recognize that neither of these extreme views is true—adult parts are not present in the germ, nor is the latter homogeneous—but for more than a hundred years opinions have been vibrating in the field between these two extremes.

Students of development, whether it be that of the individual or of the race, are like those ancient mariners who sailed that dreaded strait on the one side of which frowned Scylla and on the other roared Charybdis—in shunning the Scylla of preformation they run into the Charybdis of epigenesis, in avoiding the rocks of predetermination they fall into the whirlpools of no-determination, in avoiding the perils of fatalism they encounter the dangers of chaotic freedom—while the narrow channel of truth runs somewhere between these two extremes. They tack from one side to the other, ever advancing, ever leaving old dangers behind, ever meeting new ones—and so the science of development zig-zags on.

At present there can be no doubt that we are sailing nearer the preformation coast than at any time since the modern study of development began under von Baer. In the study of heredity great emphasis is placed, and necessarily so, upon the complexity of the germ and the intrinsic factors of development. There can be no doubt that the main characteristics of every living thing are unalterably fixed by heredity. Men differ from horses or turnips because of their inheritance. Our anatomical, physiological and psychological possibilities are predetermined in the germ cells. Whatever the ultimate relations of mind and body may be, there can be no reasonable doubt that both have developed together from the germ and that the laws of inheritance apply to one as certainly as to the other. The main characteristics of our personalities are born with us and can not be changed except within relatively narrow limits. "The leopard can not change his spots nor the Ethiopian his skin," and "though thou shouldst bray a fool in a mortar with a pestle yet will not his foolishness depart from him." Race, sex, character are predetermined in the germ cells, perhaps in the chromosomes, and all the possibilities of our lives are there fixed, for who by taking thought can add one chromosome, or even one determiner, to his organization?

These modern theories of heredity are profoundly influencing human thought in many fields. We formerly heard that all men were created free and equal; we now learn that all men are created bound and unequal. We were once taught that voluntary acts, if oft repeated, become habits, and that habits determine character; we now learn that acts, habits and character were foreordained from the foundation of the family. We once thought that men were free to do right or wrong, and that they were responsible for their deeds; now we learn that our reactions are predetermined by heredity and that we can no more control them than we can control our heart beats. For ages men have believed in the influence of example, in the uplift of high ideals, in the power of an absorbing purpose; for ages men have lived and died for what they believed to be duty and truth, and have received the homage of mankind; or they have lived malevolent and criminal lives and have been despised

by men and punished by society. But if our reactions, habits, characters are predetermined in the germ plasm such men have deserved neither praise nor blame. If personality is determined by heredity alone, all teaching, preaching, government, is useless; freedom, responsibility, duty are delusions; whether men are useful or useless members of society depends upon their inheritance, and the only hope for the race is in eugenics—always supposing that enough freedom is left to men or to society to control the important function of choosing a mate.

Already a few enthusiastic persons have begun to apply these doctrines to practical affairs. We are told that children should never be admonished or punished, for they do only what their natures lead them to do; the nature of the child must be respected and must be allowed to manifest itself in its own way. Lying and stealing will cure themselves like the mumps, or they will remain incurable, in which case the germ plasm is to blame and nothing could have been done, anyway. Laziness is due to inheritance or to parasites; the latter kind may be cured, but not the former. Thriftlessness, alcoholism and uncleanness run in families and can be cured only by extermination. Men who prey upon society were born with wolfish instincts, and can not help but eat the lambs. Villains, lawbreakers, murderers should be pitied but not punished; if blame attaches to their deeds it falls upon the marriage bureau and the parents. The world needs hospitals and sanatoria and sterilization institutes for the criminals and vicious, but not courts and prisons, and all punishments should be visited only upon the parents to the third and fourth generations.

Do our studies of heredity lead us to any such radical conclusions? If they do we must accept them like brave men. "Truth is truth if it sears our eyeballs." But when theories lead to such revolutionary results it behooves us to examine carefully those theories to see if there is not somewhere a fundamental flaw in them. Have we not sailed a little too close to the preformation coast and grounded our ship on the rocks of predetermination?

One of the most difficult things in the world is to recognize a great truth, to feel its significance, and yet not be carried away by it. Great scientific errors are frequently due not so much to faulty observations as to sweeping conclusions. In biology the search for universal laws is a peculiarly dangerous pursuit. In philosophy great errors are often due not so much to false premises as to supposed logical necessities. A logical chain has led many a man into the bondage of error. Truth is not usually found in extremes, in "carrying out a process to its logical conclusions," but rather in some middle course which is less striking but more judicious.

Having observed that the main characteristics of our minds as well as of our bodies are inherited, it is easy and natural to go further and to conclude that not only all the possibilities of our lives are marked out in the germ, but that all that will actually develop from the germ is there determined and can not be altered. There are many similarities between such an extreme view and the old doctrine of preformation, and it contains a like absurdity. It practically denies development altogether. If the germ is a closed system and receives nothing from without, and if adult characteristics are predetermined in the germ, they are as irrevocably fixed as if they were predelineated.

At the opposite extreme is the view with which we are all familiar, viz., the will is absolutely free; no taint of heredity rests

on the mind or soul; character is a *tabula rasa* on which the self writes its own record as it pleases and is responsible for the result. This view, like the old epigenesis, virtually postulates a new creation for each individual. So far as the mind and soul are concerned there is no hereditary continuity with past generations and none with future ones. But while such a view may be logically complete and theologically satisfying, it is not scientific, for it contradicts the evidence.

The truth then seems to lie somewhere between these two extremes. Our personalities were not absolutely predetermined in the germ cells from which we came, and yet they have arisen from those germ cells and have been conditioned by them. When it is said that any characteristic is predetermined in the germ cell, what does this mean? What but that the development of that characteristic is made possible? Adult characteristics are potential and not actual in the germ, and their actual appearance depends upon many complicated reactions of the germinal units with one another and with the environment. In short, our actual personalities are not predetermined in the germ cells, but our possible personalities are.

In all organisms the potentialities of development are much greater than the actualities. In many animals a small part of the body is capable, when separated from the remainder, of producing a whole body, though this potency would never have become an actuality except under the stimulus of separation. In like manner a part of an egg may, when separated from the remainder, give rise to an entire animal. By modifying the conditions of development animals may be produced which have one eye, many eyes, or no eyes; animals in which the bodies are turned inside out or side for side; animals in which all sorts of dislocation of organs have taken place; and the earlier the environmental forces act the more profound are the modifications produced. But leaving out of account all forms which are so monstrous that they are incapable of reaching maturity, we find that there are left many variations in the size and vigor of the body as a whole, as well as of its parts; many variations in the more or less perfect correlation of these parts with one another, which were determined by the conditions of development rather than by heredity. In a given germ cell there is the potency of any kind of organism that could develop from that cell under any kind of conditions. The potencies of development are much greater than the actualities. Anything which could possibly appear in the course of development is potential in heredity, and under given conditions of environment is predetermined. Since the environment can not be all things at once, many hereditary possibilities must remain latent or undeveloped. Consequently the results of development are not determined by heredity alone, but also by extrinsic causes. Things can not be predetermined in heredity which are not also predetermined in environment.

Functional activity, or use, is one of the most important factors of development. Functional activity is response to stimuli, which may be external or internal in origin. The entire process of development may be regarded as an almost endless series of such responses on the part of the organism, whether germ cell, embryo, or adult, to external and internal stimuli. It is a truism that use strengthens a part and disuse weakens it; it is likewise a truism that responses which are oft repeated become more rapid and more perfect, and in this way habits are formed. Practically all education, whether of man or of lower ani-

mals, consists in habit formation, in establishing constant relations between certain external or internal stimuli and certain responses of the organism. At first these stimuli are largely of external origin; later the external stimuli may be replaced more and more by internal ones; but whatever the source of the stimulus, the response of the organism to these stimuli is one of the most important factors of development, whether of the body or of the mind.

Among organisms a given cause does not always produce the same effect; this does not necessarily involve any violation of the law of causality, since it is highly probable that in responding to a stimulus the organism itself undergoes some change, and in subsequent repetitions of the stimulus, responses may differ because the organism is itself different. This is what is meant by "summation of stimuli," "physiological states," etc. Even in some of the simplest organisms one can observe inhibitions of responses and modifications of behavior, which seem to be due to conflicting stimuli, or to changes in the physiological state. In higher organisms such inhibitions or modifications proceed particularly from internal stimuli, which in turn are probably conditioned by hereditary constitution and past experience. The factors which determine behavior are not merely the present stimulus and the hereditary constitution, but also the experiences through which the organism has passed and the habits which it has formed.

By responsibility in the higher sense I understand the ability on the part of the individual to respond to rational, social and ethical stimuli, or impulses, and to inhibit responses to stimuli of an opposite nature; and the corresponding expectation on the part of others that the individual will so respond. The higher the type of organization the larger is the range of stimuli to which it will respond and the larger the number and kind of responses which may be called forth; and at the same time the larger becomes the power of inhibition of responses, whether through the balancing of one stimulus against another or from whatever cause. Human responsibility varies with the complexity of the stimuli involved, as well as with the capacity of individuals to respond to those stimuli. A man might be quite responsible in savage society, who would be quite irresponsible in civilized communities. In an infant there is no capacity to respond to rational, social or ethical stimuli, but with increasing capacity in this respect comes increasing responsibility. Mental and ethical imbeciles, insane and mentally defective persons, have a low capacity for such responses and inhibitions, and consequently less is expected of them. There are in different men all degrees of responsibility, as there are all degrees of capacity. In one and the same individual responsibility varies at different times and under different circumstances; it rises and falls, like the tides, in every life. Varying capacity to respond to rational, social and ethical stimuli, and to inhibit responses of an opposite nature depends not merely upon inheritance, but also upon training, habits, physiological states. The common opinion that all normal men are equally responsible is not correct; in the eyes of the law this may be true, but legal obligations are so far below the capacities of normal men that all may be held equally responsible before the law, though in reality their responsibilities are as varied as their inheritance or their training.

Conversely the responsibility of society to the individual is universally recognized. Irresponsible persons must be cared for by older or wiser persons who become responsible for them; and in general the responsi-

bility rests upon society to provide as favorable environment as possible for all its members. Experienced persons can to a certain extent choose their own environment and thus indirectly control their responses and habits, but young children are almost, if not quite, as incapable of choosing their environment as of choosing their heredity, and it becomes the duty of society to see to it that the environmental stimuli are such as to develop rational, social and ethical habits rather than the reverse.

Of all animals I suppose that man enjoys the most extensive and most varied environment, and its effect upon his personality is correspondingly great. Of all animals man has the longest period of immaturity and it is during this period that the play of environmental stimuli on the organism is effective in modifying development. In addition to the material environment he lives in the midst of intellectual, social and moral stimuli which are potent factors in his development. By means of his power to look before and after he lives in the future and past as well as in the present; through tradition and history he becomes an heir of all the ages. The modifying influences of all these environmental conditions on personality is very great. Each of us may say with Ulysses: "I am a part of all that I have met." So great is the power of environment on the development of personality that it may outweigh inheritance; a relatively poor inheritance with excellent environmental conditions often produces better results than a good inheritance with poor conditions. Of course no sort of environment can do more than to bring out the hereditary possibilities, but, on the other hand, those possibilities must remain latent and undeveloped unless they are stimulated into activity by the environment.

Not only the possibilities of development, but also the actual, developed capacities of men, are much greater than the habitual demands which are made upon them. How often have we surprised ourselves by doing some unusual or prodigious task! What we have once done we feel that we can do again. We realize more or less clearly, depending upon our experience, that what we habitually do is far less than we could do. It is this reserve, upon which we can draw on special occasions, that gives us the sense of freedom. I well remember a conversation which I once had with the late Dr. William Pepper. He had asked me to undertake a task which I felt incapable of performing, and I had pleaded inability, lack of time, anything to escape the responsibility. But with a confidence born of experience he said to me, "You know we *can* do what we *have* to do." In his inspiring address on "The Energies of Men," William James showed that we have reservoirs of power which we rarely tap, great energies upon which we seldom draw, and that we habitually live upon a level which is far below that which we might occupy. Darwin held the opinion, as the result of a lifetime of observation, that men differ less in capacity than in zeal and determination to utilize the powers which they have. In playful comment on the variety and extent of his own life work he said, in modest and homely phrase, "It is dogged as does it." It may be objected that the zeal and determination were inherited, but here also the hereditary possibilities become actualities only as a result of use, training, habit.

It is generally admitted that no constant distinction can be recognized between the brain of a philosopher and that of many a peasant. Neither size nor weight of brain, nor complexity of convolutions, bears any constant relation to ignorance or intelli-

gence, though doubtless an "unlimited microscopist" could find differences between the trained and the untrained brain. The brains of Beethoven, Gauss and Cuvier, although unusually large, have been matched in size and visible complexity by the brains of unknown and unlearned persons—persons who were richly endowed by nature, but who had never learned to use their talents. In all men the capacity for intellectual development is probably much greater than the actuality. The parable of the talents expresses a profound biological truth: men differ in hereditary endowments, one receives ten talents and another receives but one; but the used talent increases many fold, the unused remains unchanged and undeveloped. Happy is he who is compelled to use his talents; thrice happy he who has learned how to compel himself! We shall not live to see the day when human inheritance is greatly improved, though that time will doubtless come, but in the meantime we may console ourselves by the thought that we have many half-used talents, many latent capacities, and although we may not be able to add to our inheritance new territory, we may greatly improve that which we have.

I have once or twice in this address referred to eugenics in a way which was intended to be facetious, but I would not wish to be understood as attempting to disparage that infant industry. Undoubtedly it represents an important application of biological discoveries to human welfare; but it seems to me that it can not wisely go farther at this time than to attempt to eliminate from reproduction the most unfit members of society. Giving advice regarding matrimony is proverbially a hazardous performance, and it is not much safer for the biologist than for others. With a more complete knowledge with regard to the inheritance of human defects than we now possess, at least in many instances, it will probably be possible to give such advice wisely; but apart from certain bodily peculiarities, he would be a bold prophet who would undertake to predict the type of personality which might be expected in the children of a given union. Some very unpromising stocks have brought forth wonderful products. Could any one have predicted Abraham Lincoln from a study of his ancestry? Observe I say *predict,* and not explain after his appearance. Can any one now predict from what kind of ancestral combinations the great scholars, statesmen, men of affairs of the next generation will come? Could the capacities and careers of the members of this society—those who were born outside of Boston or Philadelphia—have been predicted? The time may come when it will be possible to predict what the chances are that the children of given parents will inherit more or less than average intellectual capacity, but since germinal potentiality is transformed into intellectual ability only as the result of development, such a prediction could not be extended to the latter unless the environment as well as the heredity were known. Society can safely eliminate its worst elements from reproduction, but it can not wisely go farther than that at present.

My distinguished predecessor in this office, in his striking address before this society one year ago, pointed out as one of the great tragedies of life the almost infinite slaughter of potential personalities in the form of germ cells which never develop. A more dreadful, though less universal, tragedy is the loss of real personalities who have all the native endowments of genius and leadership, but who for lack of proper environmental stimuli have remained undeveloped and unknown; the "mute, inglorious Miltons" of the world; the Cæsars,

Napoleons, Washingtons who might have been; the Newtons, Darwins, Pasteurs who were ready formed by nature, but who never discovered themselves. One shudders to think how narrowly Newton escaped being an unknown farmer, or Faraday an obscure bookbinder, or Pasteur a provincial tanner. In the history of the world there must have been many men of equal native endowments who missed the slender chance which came to these. We form the habit of thinking of great men as having appeared only at long intervals, and yet we know that great crises always discover great men. What does this mean but that the men are ready formed and that it requires only this extra stimulus to call them forth? To most of us heredity has been kind—kinder than we know. The possibilities within us are great but they rarely come to full epiphany.

What is needed in education more than anything else is some means or system which will train the powers of self discovery and self control. Easy lives and so-called "good environment" will not arouse the dormant powers. It usually takes the stress and strain of hard necessity to make us acquainted with our hidden selves, to rouse the sleeping giant within us. How often is it said that the worthless sons of worthy parents are mysteries; with the best of heredity and environment they amount to nothing; whereas the sons of poor and ignorant farmers, blacksmiths, tanners and backwoodsmen, with few opportunities and with many hardships and disadvantages become world figures. Probably the inheritance in these last-named cases was no better than in the former, but the environment was better. "Good environment" usually means easy, pleasant, refined surroundings, "all the opportunities that money can buy," but little responsibility and none of that self discipline which reveals the hidden powers, and which alone should be counted good environment. Many schools and colleges are making the same mistake as the fond parents; luxury, soft living, irresponsibility are not only allowed, but are encouraged and endowed —and by such means it is hoped to bring out that in men which can only be born in travail. College athletics has this much at least in its favor, that it trains men who take part in the contests to do their best, to subordinate pleasure, appetite, the desire for a good time, to one controlling purpose, it trains them to attempt what may often seem to them impossible, to crash into the line though it may seem a stone wall, to get out of their bodies every ounce of strength and endurance which they possess. Such training makes men acquainted with their powers and teaches courage, confidence and responsibility. If only we could make young persons acquainted in some similar way with their hidden mental and moral powers, what a race of men and women might we not have without waiting for that uncertain day when the inheritance of the race will be improved! Whatever the stimulus required, whether pride or shame, fear or favor, ambition or loyalty, responsibility or necessity, education should utilize each and all of these to teach men self knowledge and self control.

But it will be said that self control depends upon inheritance, that strong wills and weak wills are such because of heredity. It is true that one man may be born with a potentiality for self control which another man lacks, but in all men this potentiality becomes actuality only through development, one of the principal factors of which is use, or functional activity. An amazing number of persons have but little self control. Is this always due to defective inheritance, or is it not frequently the result of bad habits, of arrested develop-

ment? To charge defects at once to heredity removes them from any possible control, helps to make men irresponsible, excuses them for making the least of their endowments. To hold that everything has been predetermined, that nothing is self determined, that all our traits and acts are fixed beyond the possibility of change is an enervating philosophy and is not good science, for it does not accord with the evidence. It is amazing that men whose daily lives contradict this paralyzing philosophy still hold it, as it were, in some water-tight compartment of the brain, while in all the other parts of their being their acts proclaim that they believe in their powers of self control: they set themselves hard tasks, they overcome great difficulties, they work until it hurts, until they can say with Johannes Müller, "Es klebt blut an der Arbeit," and yet in the philosophical compartment of their minds they can say that it was all predetermined in heredity and from the foundations of the world. Whether all the phenomena of life and of mind can be explained on the basis of a purely mechanistic hypothesis or not, that hypothesis must square with the facts and not the facts with the hypothesis. It has always been true of those who "sat apart and reasoned high of fate, free will, foreknowledge absolute" that they have "found no end in wandering mazes lost." Whatever the way out of these mazes may be—whether it be found in the varied responses of an organism to the same stimulus, in the immense complexity of the mechanism involved, or in some form of idealism which finds necessity not in nature but in the spectator, and freedom not in the spectator but in the agent—it is true that for those who do not "sit apart and reason high," but who deal merely with evident phenomena, the way out of these mazes is not to be found in denying the actuality of inhibition, attention, and control. Because we can find no place in our philosophy and logic for self determination shall we cease to be scientists and close our eyes to the evidences? The first duty of science is to appeal to fact, and to settle later with logic and philosophy. Is it not a fact that the possibilities of our inheritance depend for their realization upon development, one of the most important factors of which is use, functional activity, in response to stimuli? Is it not a fact that our capacities are very much greater than our habitual demands upon them? Is it not a fact that belief in our responsibility energizes our lives and gives vigor to our mental and moral fiber? Is it not a fact that shifting all responsibility from men to their heredity or to that part of their environment which is beyond their control helps to make them irresponsible?

This debilitating philosophy in which everything is predetermined, in which there is no possibility of change or control, in which there is hypertrophy of intellect and atrophy of will, is a symptom of senility, whether in men or nations. We need to return to the joys of a childhood age in which men believed themselves free to do, to think, to strive, in which life was full of high endeavor and the world was crowded with great emprise. We need to think of the possibilities of development as well as of the limitations of heredity. Chance, heredity, environment have settled many things for us; we are hedged about by bounds which we can not pass; but those bounds are not so narrow as we are sometimes taught, and within them we have a considerable degree of freedom and responsibility.

> That which we are we are,
> One equal temper of heroic hearts
> Made weak by time and fate, but strong in will
> To strive, to seek, to find, and not to yield.

Edwin G. Conklin

Princeton, N. J.

SCIENTIFIC NOTES AND NEWS

PROFESSOR E. B. WILSON, of Columbia University, was elected president of the American Association for the Advancement of Science at the Cleveland meeting. A report of the meeting and a list of the other officers elected will be found above. National scientific societies meeting at Cleveland elected presidents as follows: The American Physical Society, Professor B. O. Peirce, of Harvard University; the American Botanical Society, Professor D. H. Campbell, of Stanford University; the American Psychological Association, Professor C. H. Warren, of Princeton University; the Society of the Sigma Xi, Professor J. McKeen Cattell, of Columbia University; the American Society of Naturalists, Professor Ross G. Harrison, of Yale University.

AT the annual election of the American Philosophical Society held on January 3, 1913, the following were elected:

President: William W. Keen.

Vice-presidents: William B. Scott, Albert A. Michelson, Edward C. Pickering.

Secretaries: I. Minis Hays, Arthur W. Goodspeed, Amos P. Brown, Harry F. Keller.

Curators: Charles L. Doolittle, William P. Wilson, Leslie W. Miller.

Treasurer: Henry La Barre Jayne.

Councillors: Charlemagne Tower, William Morris Davis, George Ellery Hale, R. A. F. Penrose, Jr., Samuel W. Pennypacker.

THE eighty-first annual meeting of the British Medical Association will be held in Brighton beginning July 22. Dr. W. A. Hollis, consulting physician, Sussex County Hospital, is the president-elect. The address in medicine will be delivered by Professor G. R. Murray, physician to the Royal Infirmary, Manchester. The address in surgery will be delivered by Sir Berkeley Moynihan, professor of clinical surgery in the University of Leeds. The popular lecture will be delivered by Mr. E. J. Spitta.

THE John Fritz medal, awarded annually by the four great engineering societies, has been awarded this year to Mr. Robert Woolston Hunt for his contributions to the development of the Bessemer steel process.

THE Academy of Medicine, Paris, has elected Professor Delezenne an honorary member of the section on anatomy and physiology to fill the vacancy caused by the death of Professor Marc Sée.

DR. W. E. BYERLY, Perkins professor of mathematics at Harvard University, will become professor emeritus at the close of the academic year.

DR. CARL PAAL, director of the laboratory for applied chemistry at Leipzig, and Dr. Fritz Förscher, director of the laboratory for inorganic chemistry in Dresden Technical School, have been elected members of the Leipzig Academy of Science.

PROFESSOR ANDREW BOSS, in charge of the department of farm management of the department of agriculture of the University of Minnesota, has declined an offer to become director of the new government demonstration farms and trial gardens at Mandan, N. D.

PROFESSOR CHARLES PALACHE, of Harvard University, using a fund placed at his disposal by A. F. Holden, '88, has spent six weeks in Maine and New Hampshire collecting minerals for the Mineralogical Museum and the teaching collections.

ASSOCIATE PROFESSOR FREDERICK STARR, of the department of sociology and anthropology in the University of Chicago, has returned from a six months' expedition to Liberia, the purpose of which was to investigate the social and economic conditions of that region. He was accompanied by Mr. Campbell Marvin, a graduate student of the university.

DR. THOMAS L. WATSON, professor of geology in the University of Virginia, addressed the graduate students in geology at Northwestern University, last month, on the "Occurrence and Geology of Rutile, with Special Reference to the Virginia Deposits."

DR. LEWIS SWIFT, formerly director of the Warner Astronomical Observatory at Rochester, and of the Mount Lowe Observatory on Echo Mountain, California, known for his discoveries of comets and nebulæ, died at Binghampton, N. Y., on January 5, aged ninety-three years.

Mr. Henry D. Mosenthal, a British chemist, known for his work on explosives, died on December 18, aged sixty-two years.

Dr. Rudolf Schimmack, docent for mathematics at Göttingen, has died at the age of thirty-two years.

The publishing house of Julius Springer, Berlin, announces the publication beginning with the new year of a new weekly journal "Die Naturwissenschaften," which, according to the announcement, "für den deutschen Wissenschaftsbetrieb ungefähr das leisten soll, was die 'Nature' für den englischen und die 'Science' für den amerikanischen leisten." The numbers will contain about 24 pages; the subscription price will be 24 Marks. The *Naturwissenschaftliche Rundschau,* edited by Professor W. Sklarek and published by Friedrich Vieweg und Sohn, which for twenty-seven years has maintained high scientific standards, will be merged in the new journal.

The number of visitors to the Zoological Gardens, London, for the past year exceeded 1,000,000, the highest on record, and in accordance with the intention of the Zoological Society the millionth person to pass the turnstiles was presented with a free pass to the gardens for 1913.

A meeting of the executive committee having charge of the arrangements for the British Association meeting in Birmingham next year was held, as we learn from the London *Times,* on December 5. Mr. Howard Heaton, on behalf of the honorary secretaries, presented an outline of the program, which included an average of five engagements each day for eight days, beginning on September 10. In addition to the usual business meetings and scientific discussions, there will be an inaugural address by the President (Sir William White) on Wednesday, a garden party and reception by the Lord Mayor on Thursday, a garden party given by Messrs. Cadbury at Bournville on Friday, excursions to places of interest in neighboring counties on Saturday, special services in the churches on Sunday, an entertainment by the local committee on Monday, and a garden party on Tuesday. For the benefit of the general public there will be two evening discussions and six popular lectures by eminent scientists during the week. The suggested program was adopted and referred to a sub-committee to be carried out. Sir George Kenrick presented the report of the finance sub-committee, which stated that the amount required to cover the local expenses of the meeting would probably be not less than £6,000. About half that sum had already been promised in response to private appeals by members of the finance sub-committee, and a public appeal would be issued at the beginning of the new year.

The Melbourne meeting of the Australasian Association for the Advancement of Science, as stated in *Nature,* will be held on January 7–14. The president-elect is Professor T. W. E. David, C.M.G., F.R.S., and the retiring president Professor Orme Masson, F.R.S. The meeting will be held at the university, which is surrounded by large grounds, and can provide ample accommodation. Professor Baldwin Spencer, F.R.S., who is spending the year as chief protector of aborigines in the Northern Territory, will deliver a lecture on some of the results he has obtained. A joint discussion of several sections will be held on the genus Eucalyptus and its products. A forest league is being formed in the various states, under the auspices of the association, which it is hoped will rouse public opinion to the necessity of preserving forests, especially round the head waters of the rivers. A large number of committees will present reports, and a full program of papers is expected. The following are the presidents of sections: Astronomy, Mathematics and Physics, Professor H. Carslaw; Chemistry, Professor C. Fawsitt; Subsection Pharmacy, Mr. E. F. Church; Geology and Mineralogy, Mr. W. Howchin; Biology, Professor H. B. Kirk; Geography and History, Hon. Thos. M'Kenzie; Ethnology and Anthropology, Dr. W. Ramsay-Smith; Social and Statistical Science, Mr. R. M. Johnston; Agriculture, Mr. F. B. Guthrie; Subsection Veterinary Science, Professor Douglas Stewart, Engineering and Architecture, Col. W. L. Vernon; Sanitary Science and Hygiene, Dr. T. H. A. Valintine; Mental Science and

Education, Sir J. Winthrop Hackett. The general secretary for the meeting is Dr. T. S. Hall.

PROFESSOR WALTER N. LACY, of the Anglo-Chinese College at Foochow, China, writes to Professor J. C. Branner, of Stanford University, the following in regard to the work of ants and termites in China. The paper referred to is published in the *Bulletin* of the Geological Society of America, Vol. 21, 449–496.

I have read with much pleasure your paper on the geologic work of ants in tropical America, for which I have to thank you. One or two items from this part of the world, regarding the termites or white ants may be of interest to you, although Foochow is in lat. 26° 58′ N.—not quite within the tropics.

On pages 478 and 479 you refer to the common ants being enemies of the white ants, and the two not thriving together. A friend of mine in the northwest part of this province has tried successfully placing black ants' nests under the house which was occasionally attacked by the white ants, and found that they were completely rid of the latter, without being in any way inconvenienced by the common ants.

On page 491 you say: "I am not aware that they (the white ants) ever attack living trees." It is not at all uncommon in these parts to find their mason-work passage-ways built up the trunks of growing trees. A few years ago an olive tree near our house was blown over in a typhoon, and it was discovered that the entire tree had been riddled by the white ants; although the tree trunk was from 18 to 24 inches in diameter, little had been left but the outer shell and bark of the tree and the leaves on the branches. For the white ants to do away with trees in this way is not rare, but, as you suggest, their work is not done in a night, but through a considerable period of time, without doubt.

UNIVERSITY AND EDUCATIONAL NEWS

GRINNELL COLLEGE received on December 24 a Christmas gift of $50,000. The money was made immediately available, to be used for any purpose, the donor stipulating but one condition, namely, that his name should never be made public.

MRS. JOHN HALL has given £500 to Sheffield University in memory of her husband. The income will provide each year a gold medal to be awarded to the student who does best in the subject of pathology at the examination for the degree.

THE university court of Edinburgh University has given a grant to Professor Whittaker for the equipment of a mathematical laboratory for the practical training of mathematicians and for a research institution. This will, it is said, be the first laboratory of its kind in a British university.

THE general council of the University of Edinburgh has taken action to bring before members of parliament and others interested in higher education the serious danger with which the universities of Scotland are threatened by the recent interference of the treasury with their freedom of internal administration.

CERTAIN citizens of Oberlin recently asked that the part of the endowment funds of Oberlin College invested in stocks and bonds should be listed for taxation. The decision ot the auditor of Lorain County has now been rendered in favor of the college, to the effect that according to the laws of the state of Ohio the college endowment funds can not be taxed.

AT Harvard University, Dr. Harvey Cushing has been appointed professor of surgery, and Dr. George Gray Sears, clinical professor of medicine. Professor Ralph B. Perry has been promoted to a professorship of philosophy.

W. S. HUNTER, Ph.D. (Chicago), has been appointed instructor in psychology in the University of Texas. F. A. C. Perrin, Ph.D. (Chicago), has been appointed instructor in psychology in the University of Pittsburgh.

MR. CHARLES FULLER BAKER, known for work in various fields of natural science, has entered the faculty of the College of Agriculture of the University of the Philippines as professor of agronomy. In the same college, Mr. A. G. Glodt, formerly of the engineer corps of the French army and a member of the Marchand relief expedition across Africa, is

associate professor of agricultural engineering. Mr. F. C. Gates, who recently finished the work for his doctorate at the University of Michigan, is instructor in botany. Mr. Edgar M. Ledyard, who spent the past year at the University of Michigan where he put the entomological collection in order and left some sixty thousand Philippine insects, has returned to his work as assistant professor in entomology. Dr. H. N. Whitford has resigned as associate professor of forest botany and silviculture, and has returned to the United States.

DISCUSSION AND CORRESPONDENCE

THE VOTE ON THE PRIORITY RULE

To the Editor of Science: A brief rejoinder may be permitted to the report by Messrs. Nutting, Williston and Ward in Science for December 13, on a vote on the rule of Priority in Nomenclature.

Primarily this vote shows something quite different from what might be inferred from a superficial examination of the report.

It means *not* that the voters have studied the conditions of confusion which the priority rule was instituted to clear up, and which produce the present temporary state of which there has been natural complaint; but that the teachers (of whom the list of voters is exclusively composed) are much annoyed by the uncertainty incident to the period of transition. This is nothing new; everybody has felt it; it requires an almost Roman firmness to give up a familiar if erroneous name; and the wonder is that the vote was not unanimous. Precisely the same state of mind is the cause why we have not yet adopted the metric system, and Russia retains the old style in her calendar.

If the question had been put as to what remedy should be had, other than continuing the work of rectification as rapidly as possible, it is likely there would have been as many minds as there were voters. No teacher likes to give a name to an organism before his classes which he is not certain is up to date. Moreover, some too clever pupil may discover that Jordan, Merriam, Allen, Elliot, Gill, Richmond, and other master systematists reject that name; where then is our infallibility? It is a tearful situation.

However, a complete remedy is at hand which will harmonize all the disputants without sacrificing accuracy or rejecting necessary rules.

It is well known that nearly all the vertebrates have what are called "common" or popular names. These have been carefully preserved by the ornithologists in their check-lists, for example.

Now let the dear old familiar names of each man's particular set of text-books be given the status of "common names," distinguished by (say a plus sign before them) to avoid confounding them with the real names, and have it generally admitted that no odium attaches to the use of a "common name" for our invertebrates, any more than in ornithology, and we have the whole problem solved. Since only one in a million invertebrates has a "common name" at present, no trouble would ensue on that score.

(I expect nothing less than a statue for this discovery, from future generations of teachers.)

Wm. H. Dall

Smithsonian Institution,
December 16, 1912

THE STAINING OF PROTOZOA

To the Editor of Science: Hæmatoxylin is, so to speak, the printer's ink of protozoologists, for this stain is used by all workers in studying the morphology of the cell, and it has come into general use because it tells as much as a single stain can of the essential structures in the architecture of a cell. It is true that various mordants alter, or rather intensify the staining character of certain parts of the nucleus. For example, when "agamous" trophozoites of *Entamœba tetragena* are stained by alum hæmatoxylin, iron hæmatoxylin, or phosphotungstic acid hæmatoxylin, or if they are stained with Mallory's phosphotungstic acid hæmatoxylin after wet fixation by Merkel's and Zenker's fluids, the different structures in the nucleus—

centriole, karyosome and sub-membranous granules, take the stain in different degrees, yet it is the same chemical basophilic substance that becomes stained.

Hæmatoxylin tells us nothing about the acidophilic substance which seems to play an important part in the physiology of the nucleus.

During the past year, working with *Entamœba tetragena,* I have been impressed by the lack of information in literature on the subject of the acidophilic substance in the nucleus of protozoa; and in descriptions of protozoa, I have noticed the frequency with which acidophilic substance has been confused with true chromatin (basichromatin). This appears to be due to the use of polychrome stains which have not been thoroughly differentiated, and to the absence of a satisfactory technique for demonstrating acidophilic substance in wet fixed films.

Those who have used the Romonowsky modifications have usually been content with over-toned or blurred pictures. In attempting to identify "*E. histolytica*" in this region and differentiate it from *E. tetragena,* our common pathogenic entamœba, I have used Romonowsky stains on films which have been so differentiated that excessive amounts of the stain have been washed out as one would differentiate preparations stained with hæmatoxylin. Inasmuch as Romonowsky stains have almost as much tendency to overstain as hæmatoxylin, the necessity for extraction of superfluous stain is manifest.

I have usually selected cover-slip preparations that contained a sufficient number of entamœbæ to warrant further study, and stained both cover-slip and object slide, thereby obtaining three pictures from one film, fresh, hæmatoxylin and polychrome. After staining, the excess of polychrome stain has been removed by means of 95 per cent. ethyl alcohol and ammoniated 60 per cent. alcohol, and I have found that when properly differentiated, the polychrome stain after dry fixation gives a picture entirely different from that of hæmatoxylin after wet fixation. It is different in two respects. It not only shows that there is an acidophilic substance—oxychromatin—within the nucleus quite different from anything yet described for *E. tetragena,* but the remainder and larger portion of the nucleus has a different structure and staining characters from that described from hæmatoxylin preparations of this entamœba.

The nucleus of *E. tetragena,* when stained with Hasting's stain followed by Giemsa's stain, and carefully differentiated with 60 per cent. ethyl alcohol, to which a few drops of aqua ammoniæ have been added (1 per cent. aqua ammoniæ in 60 per cent. alcohol) is seen to be made up of a clearly defined red substance which takes the form of a ring about the size of the karyosome or smaller. Oftener, it takes the form of a delicate reticulum or of discrete granules lying within the nuclear membrane. This red substance does not correspond in location with true chromatin (basichromatin) which stains with hæmatoxylin, and it should not be confused with basichromatin as some writers have done. The red substance, or oxychromatin, is imbedded in an ill-defined nuclear structure, staining faintly blue which sometimes is made up of slightly refractile achromatic granules of uniform size, imbedded in faintly staining blue substance and surrounded by an achromatic or faintly staining blue ring, corresponding with the nuclear membrane. The cytoplasm stains various shades of blue.

Attention is drawn to this subject with the suggestion that those interested in the cytology of protozoa pay more attention to the acidophilic substance of the nucleus—oxychromatin, for the purpose of learning what part it plays in relation to synchronous changes in the basichromatin of the nucleus and in the physiology of the cell.

It is extremely likely that so clearly defined a substance as the oxychromatin of the nucleus of *E. tetragena* is has an important physiological function, and it would seem that other protozoa might yield interesting and no doubt important information if studied from preparations designed to satisfactorily show basophilic and acidophilic nuclear substance.

Samuel T. Darling

THE DORSAL SCALE ROWS OF SNAKES

In these days when so much attention is being given to the variations and minute characters of animals it seems remarkable that such an important trait as the number of dorsal scale rows in the snakes should receive careless treatment. This character is given considerable weight in delineating species and deserves careful attention. From the descriptions one could only conclude that each species has a rather definite number, 17, 19 or 21, as the case may be, and that the variations are abrupt. The facts are far from being as simple as this. As a rule the number of scale rows decreases posteriorly, and there is often a decrease anteriorly, so that the maximum number of rows (the number now given in descriptions) may either extend from the head to beyond the middle of the body, or be restricted to a longer or shorter distance on the middle, sometimes only for the length of two or three scales. Furthermore, the species that exhibit a variation of two or more entire rows on the anterior part of the body also show the intermediate stages in which the extra rows are present on the middle of the body only, which leaves no doubt that the variations in this character are not abrupt but gradual.

From these facts it is evident that the average number of rows characteristic of a species in any region can only be expressed by a formula that gives the number of rows on the different parts of the body. It is not enough to say that a species has a maximum of 21 rows; one should at least know whether the number is 21 for the greater part of the length or only on the middle of the body. Quite evidently a form with an average of 21–19–17 scale rows, which means 21 to beyond the middle and 19 and then 17 posteriorly, is not the same as one in which the scale formula averages 19–21–19–17, any more than one with 21–19–17 rows is the same as one with 19–17 rows, although such variations are thrown together under the present way of recording the rows.

It is a simple matter to count the number of rows on the different parts of the body and this may be conveniently expressed by the formula given above. At least this much should be done by the herpetologist, if not for the systematist then for the student of geographic variation, for only with this data can one determine the variation in this character and the type in each locality.

Alexander G. Ruthven
Museum of Natural History,
University of Michigan

THE QUESTION OF TEXT-BOOKS IN COMPOSITION

When a Harvard man thinks of books on English composition he thinks of Professor Wendell, and before him Professor Hill, and before him the dark. Professor Hill's books, though immensely comforting and instructive, ought to be considered as reference books rather than as texts. Therefore, in the winter of 1890–91, when Professor Wendell found himself confronted with the problem of lecturing on composition to a Lowell Institute audience, he looked about him to see what had already been done. He was surprised to find that nothing then in print quite served the turn. All these earlier fellows were too technical and too much absorbed in detail. They laid down hard and fast rules. They had no patience with the growing tendency to say, "It is me." Students could scarcely tolerate their etymology, their prosody, their similes and their metaphors. Professor Wendell felt already, we may assume, something of his present fine impatience with the details of scholarship; he was already, on his academic side, professionally unconventional. Here, then, was a man peculiarly gifted by nature for the work of cleaning house in rhetoric. There resulted the Lowell lectures, and, in time, the "English Composition."

Since then nobody, I believe, has dared to depart from Professor Wendell's ways. We have had composition books written by nearly everybody, for nearly every important institution and academic grade; but none in any essential respect different from the first. Latterly they become more full of illustrative material and exercises. They present examples of faulty and correct writing from

every modern source, beginning with the newspapers and ending with Colonel Bryan and Sarah Orne Jewett. A few have made some additions to the original theory. They undertake to show a logical subdivision of the plans on which paragraphs may be built up. Beyond this there is little difference. The principles of composition, no matter who expounds them, still bear the hall-mark of their origin. They are all dilute and popular. They all present vague, sweeping precepts which relate to criticism, and not at all to the art of writing. These are so abstract that special exercises must be invented to illustrate them, and so lacking in specific helpfulness that any attempt seriously to fix the student's attention upon them quickly kills his desire to write. Between students who find them incomprehensible and those who think them obvious and silly, there is only a small middle class. It consists of those adapted by nature to take orders and obey with mechanical faithfulness.

Some ten years ago these words might properly have been regarded as destructive criticism. At present they can not, for there is little now left to destroy. Few successful teachers of composition now pay much attention to text-book work. Individual conferences with students have partly replaced it. These, however, are now taken for granted, and we no longer write to the papers about them. A newer device, and one even more welcome, because it occupies class-room hours, is "oral composition." Though burdened at the start with the most unattractive name that could have been chosen, "oral composition" has been an enormous success. More than one high-school teacher of English has seen it double the interest in his work. No wonder. It gives the student, what the text-book never furnished, a rational ideal and an intelligible standard by which to judge success.

The principles of English composition, while they lasted, were hardest on us teachers. We, at least, were forced to take them seriously. The burden of illustrating these mechanical rules fell on us. Now a great musician, one imagines, may go through his five-finger exercises, or what not, and by and by assimilate his technique and perform with the regulated freedom of genius. Whether it can be so with a writer will perhaps never be known. Certainly it can not be proved by us teachers of composition, for none of us was a genius to begin with. We arrive at a state of mechanical perfection in technique, and there we stick. I look back, in my own case, upon the ruin of a promising and individual, though not a solid or brilliant, style. Now-a-days I write with the mechanical regularity of one pumping into a bucket. I have been a faithful disciple of Professor Wendell, and I can now write a paragraph as "theoretically perfect in mass" as anything to be found in the *Nation*. I can write a paragraph explaining what a paragraph should be, and at the same time explaining that the paragraph I am writing illustrates what a paragraph should be; and I can bring both ideas together at the end into the same summary! But suppose me very angry, or very serious about my subject, so much disturbed, in fact, that I was beside myself, and forgot the principles of English composition. Could I then write any paragraph at all? Probably not. No more than a bricklayer could lay a brick without his trowel. Almost the only thing of which I am any longer capable is what Professor Wendell calls "a piece of style."

There should be comfort in the fact that I am not alone. Most of the brotherhood of English teachers is in the same state. If a man has taught composition any time these twenty years, he is marked. You recognize his method as far away as you can read his work. To conclude a paragraph with a summary is for him as unavoidable as to expel breath after inhaling. His style crawls over the page like an inch-worm, constantly measuring its heels up to its chin. I think of these things, and I wish I were upon the hill of Basan, to outroar the horned herd!

The possibility of slighting the text-book work is, of course, entirely agreeable to many teachers of English. They find it in keeping with modern methods in education. School

is let out, there are to be no more tasks, nothing but playing cross-tag with the boys in the yard and developing the "class consciousness." There is among us, as in other subjects, the type of man properly called an "educator." He "draws out" his pupils. Always animated, always with the last word from the *Scientific American* or the *Review of Reviews*, he makes his class-hour a little less interesting than the moving pictures, but more so than a star lecture at the Y. M. C. A. Such a man likes to see bright faces about him. He is accustomed to have his hour looked forward to with pleasure, his classes begging to be allowed to write ten pages, while he sternly holds out for five. His work is "inspirational"; to make it succeed, he must be in the best of physical condition. So he saves himself. He lets his students criticize their own compositions and those of one another. For himself, he resolves to read themes less, and to play golf more. Such a man is merely an accident in an English classroom. If his occupation were adapted to his essence, we should find him preaching on politics and current problems in a modern evangelistic city church. But, as he stands, his students look up to him as a polished gentleman and man of the world. From him they draw culture in the vaguer sense, a dissemination of sweetness and light.

Meanwhile, there is still the teacher. He is to be found in all subjects, even English composition. He hates inexactness and vagueness, he loves to enforce a clear intellectual distinction, he has great confidence in the educational value of abstract thought. On these accounts he is very unhappy, at the moment, in the English class room. The birch was taken away from him long ago, and now they have taken the book. His conference work goes well enough, being confined mostly to punctuation, grammar and the split infinitive; but in the class he finds nothing to do that he considers worth while. His text-book distresses him with its lack of content. How can he hold up his head before his classes as a man of intelligence when he is obliged to spend his hours with them in discussing principles which would be evident to the child of ten? He was better off in the dark ages, before they made the whole business so simple. Then, at least, there was material for mental exercise.

It is this style of man who does the real work of the schools, that for which parents suppose they are paying. He is less conspicuous than the "educator," for teaching is a curious business. It is the only profession in which men appear to succeed best by neglecting their work and doing other things. At the same time, as it is not now a question of promotion or salary, we may admit that this man of solid, thoughtful mind is the only real teacher. And the question comes up: What are we to do to keep him happy in English composition?

If we assume that no college teacher wants to do his plain duty, and teach spelling and grammar, there are still two other directions in which the outlook for new text-books is more or less hopeful. The first is logic. That subject has been for some time neglected, and now tends to seem a part of "the good old times." College teachers have begun to ask themselves whether they can not introduce some training in logical principles into the English course; though at the outset they are somewhat staggered at the memory of "Barbara, Celarent." Some day there will be a shaking among those dry bones, and then we shall have a text-book for the teacher.

The second direction from which light may come is the artistic treatment of prose. The artistic problem behind the student's theme, if he can be made to see it, will interest him. It will interest also the "educator" and the teacher. If we could find a man among us who is by nature an artist, rather than a critic, he might contrive to tell us how to write. This sort of book is the hardest of all to produce, and the least likely to appear; but, if one could make it, it would be worth as much as all that has yet been written.

A. T. Robinson

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SCIENTIFIC BOOKS

Higher Mathematics for Chemical Students. By J. R. PARTINGTON. New York, D. Van Nostrand Co. 1912.

A first question is: Do chemists need any higher mathematics? And it must be admitted that the inorganic analytical chemist, the organic synthetic chemist, the agricultural chemist, and a host of others, by a large margin the majority of all, do not need much, if any, mathematics, and perhaps a quarter century ago no chemist was much the better off for a knowledge of the subject. Of late, however, there has been a great development of physical and dynamic chemistry, wherein mathematical methods are of great importance, so that there has come considerable demand for mathematics from a large and growing class of theoretical chemists, and the demand is likely to increase in the future. Indeed if a student desires to read such memoirs as that of Gibbs on the equilibrium of heterogeneous substances, he must have a tolerably thorough foundation in some branches of mathematics.

A second question: Is there any necessity for a special treatment of calculus for chemists? The appearance of such works as Mellor's "Higher Mathematics for Students of Chemistry and Physics" and this work of Partington's would seem to imply that there was. And the publication of special texts for engineers, economists and the like is evidence that others than chemists feel such a need. In this connection we may cite the excellent address by C. Runge at the International Congress of Mathematicians in Cambridge last summer on the university training of the physicist in mathematics. It is there pointed out with force, but kindness, that our mathematicians do not organize their course of instruction with sufficient reference to the advantages of the great majority of their students, namely, those who are going into physics, chemistry, economics, engineering, and, indeed, anything except pure mathematics—and in so organizing them they are not making for any very preponderating advantages for the few students of pure mathematics.

The sort of course in calculus that the elementary student of applied mathematics should have is one where the ideas and methods of differential and integral calculus, including differential equations, are most fully emphasized and thoroughly illustrated by simple formal work applied to a great variety of problems. For it must be remembered that nine tenths of the problems where the student will use his calculus can be treated with the simplest sort of analysis. So long as mathematicians insist upon a training in differentiation and integration which requires the exercise of a considerable amount of advanced algebra and analytical trigonometry, the student of the elementary applications will find himself burdened with unnecessary material which may be hard for him and which can not fail to distract his attention from the work he most needs. And just so long there will be attempts, justifiable attempts, to compile treatises out of the line of the regular mathematical courses for the use of such students.

Whenever a book thus intended for a special class appears it must be judged from a double point of view: First, how is it as mathematics; second, how does it meet the needs of that special class?

Judged from the point of view of the mathematician, Partington's work is far from good; it has that sort of inaccuracy which indicates that its author, no matter how much he may use his mathematics, does not have any thorough knowledge of the subject; it abounds in the kind of glaring crudities with which every serious teacher is familiar on the part of his pupils and which he seeks constantly to eliminate, though often unsuccessfully, from their minds. A few instances must be cited to justify so sweeping a condemnation.

On page 21 in the definition of limit the statement that the variable can never reach its limit is incorporated. With the artificial discontinuous variable of elementary geometry this is true, though unessential; with the continuous variables of physics it is not true. On page 31 in varying the equation $pv = K$ by assigning increments to the variables the author writes

$$(p + dp)(v - dv) = K.$$

Now $v - dv$ in place of $v + dv$ is just the sort of error we have constantly to warn the freshman against. The increment dv may be negative, but should not be written as $-dv$. The author finds the correct result $dp/dv = -p/v$ incorrectly from an incorrect equation. On page 67 there is this choice bit: "At this point (such as P) there is a sudden change of direction; it is therefore called a *point of inflection.*" A fine definition! How could the author have made more errors in so short a sentence! On page 86 we find: "It must not be supposed, however, that the series obtained by differentiating a convergent series term by term is also convergent. Thus the series

$$1 + x^1 + x^{1\cdot 2} + x^{1\cdot 2\cdot 3} + x^{1\cdot 2\cdot 3\cdot 4} + \cdots$$

is convergent for $|x| < 1$, but the series

$$1 + 2x + 6x^5 + \cdots,$$

obtained by differentiation, is divergent for all values of x." Now if there is any one fact better known or more fundamental than that a power series which converges is differentiable term by term and yields a convergent series, we fail to know what it is. This sort of mistake can arise only when ignorance is blatant enough to talk about matters of which it is so completely ignorant that it does not even recognize its ignorance. No author can wholly avoid errors, but here they are too many and too gross for any charitable inference.

But this book is intended for chemists, and in justice it should be judged chiefly upon what it does for them, what it gives them that they need, what it spares them that for them would be superfluous. Here we must admit that we think the work a great success. To the mathematician, the physicist or the electrical engineer the total omission of all reference to the circular functions and their inverses would seem incomprehensible. But the chemist has no need of oscillating functions; his phenomena run one way. The restraint that the author has exhibited in leaving entirely aside the trigonometric functions is therefore highly commendable. Again, the author uses differentials in differentiating and gives a tolerably full account of partial differentiation, of the total or exact differential, and of circuit integrals. These matters are of great importance to the chemist. Moreover, though his work is chiefly elementary calculus, it somewhat justifies the more general title Higher Mathematics by the introduction of methods of interpolation, extrapolation, approximation formulas and the like, and it finds place on almost every page to appeal to the chemist by selecting exclusively for its applications problems which actually arise in that subject.

The titles of the chapters will give an idea of the scope of the text. Functions and limits, rate of change of a function, differentiation of algebraic functions, maximum and minimum values of a function, exponential and logarithmic functions, partial differentiation, interpolation and extrapolation, the indefinite integral (two chapters), definite integrals, application of the definite integral, differential equations (two chapters), and appendices containing the theory of quadratic equations, the solutions of systems of linear equations by determinants, approximation formulas, and a tabulation of the exponential and natural logarithmic functions. As has been stated, everywhere are found detailed and vital applications to chemistry, to which the list of entries in the index bears ample witness. The student who masters the text will do so with the fullest appreciation of its use to him and will attain a knowledge sufficient for most of his needs, albeit if he wishes to read such highly mathematical works as Gibbs's papers he must pursue his studies somewhat further. For the class for whom it is designed the book is far more useful than the ordinary text on calculus.

Edwin Bidwell Wilson
Massachusetts Institute of Technology

Allgemeine Biologie. Vierte umgearbeitete und erweitete Auflage. Von Oscar Hertwig. Jena, Gustav Fischer. 1912. Pp. 787, mit 478, teils farbigen, Abbildungen in Text.

The appearance of a fourth edition of this

standard work so soon after the publication of the third (1909) is convincing evidence of its usefulness. Indeed there is no other recent work which deals with such a wealth of material of general biological significance; and there are few biologists who possess Professor Hertwig's facility for clear and forcible presentation. The book is thoroughly readable. Each edition has been an improvement over the preceding, and the present is no exception, through elimination in a few places, but mainly by the addition of entire new sections, and by incorporation of later results in many places throughout. Thus the new matter of the present edition includes the action of β and γ rays on animal and plant tissues, results of tissue culture methods, and the subject of sex-determination. The subjects of chondriosomes, chemotherapy, dimorphism of spermatozoa, heterochromosomes, graft hybrids, hormones, secondary sexual characters and inheritance of acquired characters have been thoroughly revised and brought up to date. These additions and revisions are those noted in the preface, but the revision runs pretty well through the book.

A great merit of the book is that the author, though zoologist, by no means limits himself to animals in the discussion of biological principles, but makes free use of botanical results throughout. His botanical illustrations are often very illuminative, and the constant combination of animal and plant material serves to emphasize the conception of general biology as treatment of the phenomena of life common to animals and plants.

Professor Hertwig still opposes the prevalent view that the problems of biology are fundamentally problems of physics and chemistry. Even if we were to assume, he asserts, that at some remote time the science of chemistry should be so developed as to reveal the structure of all possible albuminous molecules and their derivatives, and that it provided methods by means of which we could ascertain what kinds of albumen and other organic molecules were present in the cell and in what quantities, we should not thereby gain insight into the essence of the living cell and of protoplasm. And why? Because the cell is not "living albumen," as has sometimes been said, or a mixture of innumerable albuminous molecules, but an organism composed of determinately arranged vital units, which are again complexes of albuminous molecules and therefore endowed with properties as different from the properties of the simple albumen molecule as the latter from the constituent atoms.

It is perhaps presumptuous, even in so seasoned and honored a veteran as Professor Hertwig, to venture to lay down the limitations of chemical research with reference to biology, and the bounds of the insight that future advance may yield into biological problems, for a reason that will appeal only to those biologists who still use "vital units" in thinking and conceive they know their properties. In any event, such a point of view has its obvious limitations, and they are felt in the treatment of many subjects in the book. On the other hand, this exclusively biological attitude is often of the greatest value in the criticism of premature or narrow generalizations of bio-chemists; and in several places Professor Hertwig's broad outlook on the biological field more than compensates for underestimation of the chemical side.

The treatment of a few subjects still remains rather antiquated. For instance, in the chapter entitled "Untersuchungen der einzelnen Reizarten" there is not a single citation more recent than 1891. And in this connection it is surely a serious defect in a work on general biology that the field of animal behavior should be entirely neglected. Another illustration of antiquated treatment occurs in the discussion concerning "Befruchtungsbedürftigtkeit der Zellen," where the whole discussion, so far as infusoria are concerned, is based on Maupas' work, while the more recent work of Calkins, Woodruff and Jennings, is not even cited. But in most subjects such neglect of recent work is not so obvious, though piety towards pioneers is always observed, as is fitting.

The theoretical foundation of the whole treatment remains as before; if it is sometimes unduly prominent, or even, as it seems to the

reviewer, strained in many places, it nevertheless has an important function in the arrangement of material, and inherent interest of its own as the matured expression of opinion of one of the makers of modern biology; but one can not say that it has promise as a working program; it represents the biological conceptions of the nineteenth rather than of the twentieth century.

The book is full of interest, and may be profitably consulted by working biologists of all grades and laymen alike.

F. R. L.

Chemical Phenomena in Life. By FREDERICK CZAPEK, M.D., Ph.D., Professor of Plant Physiology in the University of Prague. New York and London, Harper and Brothers. 1911. Pp. ix + 151.

We have before us bearing the above title an extremely interesting and valuable little book included in Harper's "Library of Living Thought." This book should prove to be of great interest to all those interested in the chemistry of life. And I take it that there are no students to-day interested in biology who are not insensibly drawn into the consideration of those varied chemical phenomena so highly characteristic of living things. To the botanist who is familiar with Czapek's "Biochemie der Pflanzen" in the German this little book (really a condensation of that great work) comes with particular interest. It was indeed a most difficult task, as the author admits, when it was attempted to put in condensed and rather *popular* form the subject matter with which he has busied himself for so many years. But it seems that this has been accomplished in a most admirable manner. However, it must not be supposed that this little volume is easy to read and understand; it is far from being adapted to the beginner in biology. The author states in the preface that "a *fair* knowledge of physics and chemistry, both organic and physical, is required, besides the great number of biological facts which must be remembered when we try to obtain a satisfactory survey of the general physiology of the plant." Consequently this book will be of most value to those who have had a university training which included the above requirements.

With Czapek's well-known contributions to this field of botany all that is necessary to do to portray the value and scope of this book is to indicate the chapter heads as follows: Biology and Chemistry; Protoplasm and Its Chemical Properties; Protoplasm and Colloid-chemistry; the Outer Protoplasmatic Membrane and Its Chemical Functions; Chemical Phenomena in Cytoplasm and Nucleus of Living Cells; Chemical Reactions in Living Cells; Velocity of Reactions in Living Cells; Catalysis and the Enzymes; Chemical Actions on Protoplasm and its Counter-actions; Chemical Adaptation and Inheritance.

Certainly every student of botany should have a copy of this book, and should read it again and again, not only for the considerable amount of subject matter here precipitated from a mass of bewildering details, but also because of the broadening of the point of view that is certain to result from its careful study.

RAYMOND J. POOL

THE UNIVERSITY OF NEBRASKA

STANDARDIZATION OF THE ACCOUNTS OF LEARNED SOCIETIES

THE United States is now supporting somewhere between 100 and 200 societies of which the object is the extension of learning, the promotion of science and common action in some field of intellectual endeavor. In a country so rich and so generous as the United States, it is not difficult to obtain support for such enterprises, and new ones are added every year. Still many of them find it hard to make both ends meet; a few are able to accumulate a permanent fund.

The accounts of these societies are almost all reported, and in most cases printed, every year; and it might be supposed that institutions founded for the inculcation of truth, exactness and efficiency would give to their supporters a detailed, analytic statement of receipts and expenditures. This is, however, far from being the case. The accounts of the societies are in general brief and far from self-

explanatory. An illustration of the methods of some of the societies, and a test of their thoroughness in keeping accounts is the annual statement for the last year available when this article was prepared, for each of four large and active national societies in kindred fields: namely, The American Academy of Political and Social Science, the American Economic Association, the American Historical Association and the American Political Science Association. Following are the reports of these four societies:

THE AMERICAN ACADEMY OF POLITICAL AND SOCIAL SCIENCE

SUMMARY OF INCOME AND EXPENDITURES FOR THE YEAR ENDED DECEMBER 31, 1910

Cash on hand January 1, 1910		$7,745.38
Income		
Annual membership fees	$22,610.16	
Life memberships	709.64	
Special contributions	1,510.00	
Subscriptions to publications and sales thereof	8,274.70	
Income from investments	2,361.91	
Income from bonds matured	4,500.00	
Interest on deposits	139.02	
		40,105.43
		$47,850.81

Expenditures

Clerical services		$6,008.18	
Printing stationery and postage in connection with publication of *Annals* and with general correspondence		19,269.82	
Office expenses		2,851.01	
Expenses of meetings		2,243.74	
Profit and loss		5.00	
Investments purchased	$12,975.00		
Interest, premiums and commissions on above purchases	266.56		
		$13,241.56	
			43,619.31
Balance, December 31, 1910			$4,231.50
Distributed as follows:			
Mortgage Trust Co. of Penna.		$3,807.50	
Centennial National Bank		200.00	
With A. S. Harvey		134.65	
With E. Tornquist		100.00	
		$4,242.15	
Less overdraft Academy Office		10.65	
			$4,231.50

REPORT OF THE TREASURER TO THE AMERICAN ECONOMIC ASSOCIATION FOR THE YEAR ENDING DECEMBER 20, 1911

I. BALANCE SHEET

Resources		*Liabilities*	
Investment	$1,000.00	Bills payable	$1,000.00
Cash on hand	390.03	Accounts payable	1,003.60
Stationery on hand	50.00	Membership dues (prepaid)	674.82
Insurance (unexpired)	32.00	Guarantee fund (prepaid)	260.00
Furniture and fixtures Sec.-Treas. Office	162.00	Annual meeting (luncheon tickets purchased in advance)	331.65
Dues receivable	492.00		
Accounts receivable	155.00		
	$2,281.03		
Deficit	989.04		
	$3,270.07		$3,270.07

II. Income Account

Expenses

Quarterly printing	$385.31	
Economic Bulletin editorial	187.32	
Economic Bulletin printing	475.33	
		$1,047.96
Proceedings and *Handbook*		1,423.86
Amer. Econ. Review printing	2,495.18	
Amer. Econ. Review editorial and manuscript	2,956.40	
Editors' expenses and supplies	1,279.01	
		6,730.59
Secretary's Office:		
Office salaries	1,583.73	
Traveling expenses	85.45	
Stationery, including office printing	223.50	
Office postage	440.15	
Office supplies	162.71	
Telegraph and telephone	26.37	
Express, freight and cartage	14.50	
Miscellaneous	27.98	
		2,564.39
Rent (storage of stock)		91.67
Insurance		33.08
Annual meeting		216.05
		$12,107.60

Receipts

Dues	$5,621.95
Subscriptions	842.26
Sales of publications	860.64
Interest	100.52
Guarantee fund	2,309.07
	$9,734.44
Deficit for the year	2,373.16
	$12,107.60

III. Surplus Account

Deficit for year	$2,373.16
	$2,373.16

Surplus at beginning of year	$1,242.12
Supplies as per inventory at beginning of year	142.00
	1,384.12
Deficit balance at end of year	989.04
	$2,373.16

The American Historical Association
Report of Clarence W. Bowen, *Treasurer*

Receipts

Dec. 19, 1910		
Balance cash on hand		$4,741.64
Dec. 18, 1911		
Receipts as follows:		
2,569 $\frac{2}{3}$ annual dues at $3.00	$7,709.00	
1 annual dues at	2.99	
1 annual dues at	3.02	
7 annual dues at $3.05	21.35	
23 annual dues at 3.10	71.30	
3 annual dues at 3.15	9.45	
4 life memberships at 50.00	200.00	
Sales of publications	532.00	
Royalties	133.41	
Interest on bond and mortgage	850.00	
Dividends on bank stock	200.00	
Sales of waste paper	7.67	
Loan, National Park Bank	1,500.00	
		11,240.19
		$15,981.83

Disbursements

Dec. 18, 1911

Treasurer's clerk hire, vouchers 16, 67, 70, 124, 136, 142	$388.00	
Secretary's clerk hire, vouchers 17, 46, 52, 56, 58, 65, 74, 75, 88, 100, 109, 116, 127, 140, 141, 154, 156 ..	797.40	
Postage and stationery, Treasurer and Secretary, vouchers 13, 18, 24, 25, 31, 44, 47, 54, 55, 63, 66, 69, 76, 86, 89, 98, 99, 104, 105, 107, 108, 111, 115, 119, 128, 130, 133, 137, 145, 147, 155, 158, 161	378.07	
Secretary of the council, vouchers 4, 34, 40, 83, 84, 126, 148, 149, 150, 176, 177	70.54	
Pacific Coast Branch, vouchers 79, 80	26.73	
American Historical Review, vouchers 38, 43, 49, 60, 71, 72, 82, 96, 113, 121, 146 ..	4,532.00	
Public Archives Commission, vouchers 30, 33, 42, 51, 85, 131, 151, 172, 178, 179 ...	370.55	
Historical Manuscripts Commission, voucher 68	30.00	
Committee on the Justin Winsor Prize, voucher 22	200.00	
Committee on Bibliography, voucher 103	50.00	
Committee on a Bibliography of American Travels, voucher 153	15.00	
Committee on a Bibliography of Modern English History, vouchers 6, 41, 125 .	56.50	
Committee on the Certification of Teachers, vouchers 134, 135, 160, 163, 164 ...	28.93	
Committee of Five on the Teaching of History in Secondary Schools, voucher 50	5.00	
Committee on Historical Sites, vouchers 7, 8, 9, 10	49.05	
Committee on Indexing the Papers and Proceedings of the Association, vouchers 62, 81	150.00	
Committee on Writings on American History, voucher 39	200.00	
Conference of Historical Societies	15.75	
General Committee, vouchers 11, 12, 15, 93, 168, 181 ..	200.19	
Publication Committee, vouchers 28, 29, 35, 117	32.74	
Annual Report for 1908, vouchers 90, 91, 94, 102, 122, 123, 139	129.35	
Annual Report, 1909, vouchers 106, 138, 182	52.40	
Handbook, 1911, vouchers 26, 57, 61, 97, 118	494.43	
Executive Council expenses, vouchers 5, 27, 152, 162, 165, 166, 167, 170, 171, 173, 174, 180	2.80	
Editorial work, vouchers 19, 48, 53, 64, 73, 87, 101, 112, 114, 129, 144, 157	300.00	
Furnishing Secretary's Office, voucher 78	321.52	
Expenses Twenty-sixth Annual Meeting, vouchers 1, 2, 3, 20, 21, 36, 37	116.15	
Expenses Twenty-seventh Annual Meeting, voucher 159	1.70	
Bank stock, voucher 32	2,160.00	
Collection charges, vouchers 59, 92, 110, 132, 175, 183 .	11.20	
Miscellaneous expenses, vouchers 14, 23, 45, 77, 95, 120, 143	1,545.40	
		$12,731.40
Balance cash on hand in National Park Bank		3,250.43
		$15,981.83
Net receipts 1911		$ 9,740.19
Net disbursements 1911		11,231.40
Excess of disbursements over receipts		$ 1,491.21

The assets of the Association are:

Bond and mortgage on real estate at No. 24 East 95th St., New York	$20,000.00	
Accrued interest from Sept. 29, 1911, to date	188.89	
20 shares American Exchange National Bank stock at $250	5,000.00	
Cash on hand in National Park Bank	3,250.43	
		$28,439.32
An increase during the year of ...		$921.43

New York, December 18, 1911

THE AMERICAN POLITICAL SCIENCE ASSOCIATION
REPORT OF THE TREASURER FOR THE YEAR 1911

Receipts

Balance on hand December 22, 1910 ..	$ 7.30
Annual dues	3,770.00
Life memberships	150.00
Subscriptions	231.00
Publications sold	474.74
	$4,633.04

Expenditures Aggregated

Legislative notes for *Review*	$ 100.00
Clerical assistance to Secretary and Treasurer	465.00
Printing, stationery and mailing	3,060.85
Expressage on *Proceedings*	167.24
Postage and office expenses of Secretary and Treasurer	343.41
Payment on loan	400.00
Miscellaneous	74.40
Total expenditures	$4,610.90
Balance on hand December 22, 1911 .	22.14
	$4,633.04

The methods of these societies are so different, and the direction of their outgoes so varied, that no comparison is possible without an analysis and restatement of the accounts, as below.

These tables require some explanation: in the first place there is a difference in every case between the number of paying members (found by dividing the annual receipts from members' dues by the annual fee), and the recorded number of members. In societies gaining rapidly in numbers they will never be the same, but where the difference is so great as appears in the Academy, viz., 945, the presumption is that a lot of paper members are being carried on the rolls.

The cash receipts are a function of two variables, the number of members and the annual fee: the Academy charges $5 and has

RECEIPTS OF FOUR NATIONAL SOCIETIES
FISCAL YEAR 1910

	Am. Acad. Pol. and Soc. Sci.	Am. Econ. Assoc.	Am. Hist. Assoc.	Am. Pol. Sci. Assoc.
Memberships:				
Recorded members	5,467	1,850	2,925	1,350
Paying members	4,522	1,814	2,606	1,138
Cash Receipts				
Memberships:				
Annual	$22,610	$5,621	$7,817	$3,444
Life	709	—	200	293
Total	$23,319	$5,621	$8,017	$3,737
II Publications:	8,275			
Subscriptions		842	—	183
Sales		861	532	41
Royalties		—	133	—
	8,275	1,703	665	597
III. Investments	2,501	101	1,050	—
IV. Contributions	1,510	2,309	—	—
Grand total	$35,605	$9,734	$9,740	$4,334
Invested funds and current balance	$53,000	$1,000	$28,440	—

PUBLICATION BILLS OF THE FOUR SOCIETIES (1910)

	Am. Acad. Pol. and Soc. Sci.	Amer. Econ. Assoc.	Am. Hist. Assn.	Am. Pol. Sci. Assn.
Number of paying members	4,522	1,814	2,606	1,138
Proceedings:				
Pages		463	390	226
Total words		190,000	332,000	90,000
Cost		$1,424		
Periodicals:				
Pages	1,523	980	984	639
Total words	685,000	380,000	492,000	256,000
Prize essay:				
Pages			223	
Total words			71,001	
Total words paid for by societies	685.000	570,000	492,000	346,000
Total expense of printing pub ications	$22,278	$9,202	$5,509	$3,448
Expense per 1,000 words	32.50	10 10	11.20	9 97
Expense of publications.	$22,278	$9,202	$5,504	$3,448
Receipts from publications	8,275	1,703	655	597
Net expenditures	$14,003	$7,494	$4,844	$2,851
Paid to contributors		1,456	1,500	
Net publication cost	$14,003	$6,043	$3,344	$2,851
Net cost per 1,000 words.	20.41	10.60	6 80	8.24

EXPENDITURES OF THE FOUR SOCIETIES
FISCAL YEAR 1910

	Am. Acad. Pol. and Soc. Sci.	Am. Econ. Assoc.	Am. Hist. Assn.	Am. Pol.Sci. Assn.
I. Administration:				
Salaries		1,584		
"Office expenses"	2,851	826	1,283	836
Sta., post., tel., etc.			378	
Trav. and cler. ex.		85	324	
Miscellaneous	3,000[1]	125	1,557	96
Total	$5,82	$2,620	$3,512	$932
Per paying memb.	$1. 1	$1.44	$1 35	$0.81
II. Publications:				
Annual report			(Govt)	
Proceedings		1,424	677	800[2]
Periodicals			4,532	2,548[2]
Printing, sta., post.	16,270			
Printing		3,543		
Editorial salaries		1,500	300	100
Contributors		1,456	—	—
Editors' expenses		1,279	—	
Clerical services	6,008			
Total	22,278	9,202	5,509	3,448
Per paying memb.	$4.93	$5.07	$2 11	$3.03
III. Activities:				
Meetings	2,244	216	118	—
Coms. of investgn.			1,403	
Total	2,244	216	1,521	—
Per paying memb.	$ 49	$ 11	$.58	—
Grand total	30,378	12,038	10,572	4.380
Per paying memb.	$6.71	$6 63	$4.05	$3.84

[1] Total $19,270; analyzed into items by guess.
[2] Total 3,348; analyzed into two items by guess.

nearly twice as many members as any of the other associations. None of the societies apparently makes a practise of soliciting life memberships.

The income from publications also varies, the Academy alone of the four societies having a notable sale for its publications outside its own members. The accounts of that society do not make a distinction between outside subscriptions and the sales of numbers to members of the society.

The Academy and the American Historical Association both have invested funds which add considerably to the income.

The Academy and the Economic Association in the year under review received considerable sums as contributions outright or as guarantees for some special enterprise.

The income of the societies varies from $3,600 to $40,000 a year. Those incomes, whatever their derivation or their source, should be considered as trusts to be administered for the benefit of the field of investigation and study represented by the society. All four of the societies have systems of regular publications which, in order to furnish a basis of comparison, have been calculated according to the number of thousand words. The *Annual Report* of the American Historical Association is printed by the federal government, which much relieves its budget. Each of the societies maintains a periodical—that of the Academy considerably the most voluminous. The Historical Association also publishes a prize essay, which however pays for itself out of sales.

It is difficult to ascertain from the accounts precisely how much these publications cost; but by a careful study and aggregation of items, it appears that the Academy pays $32.50 per 1,000 words, as against an average of about $10.50 by the other three associations. The edition of the *Annals* of the academy is larger—perhaps twice as large—as any of the other three societies, but anybody knows that when plates are once made, the expense of running off additional copies is a comparatively small matter. On the other hand, the Academy's cost of publication is relieved by about $8,000 of receipts. Here again the comparison is confused because the economic and historical periodicals pay contributors. Making allowance for those items it would appear that the net cost per words for the Academy is from two to three times that of the two sister societies.

In all the societies the publication forms one of three principal groups of expenditure. The Academy lumps under the head of "Printing, stationery and postage in connection with publication of *Annals* and with general correspondence, $19,269.82." It is absolutely impossible from these figures to subdivide between general administration and publication; and therefore $3,000 is by guess assigned to administration out of the total sum. On the basis of the paying members, the administration per member is about the same, but of course it ought to be distinctly less per capita for the larger society. The same remark applies to the per capita cost for publications: one of the advantages of a large membership is that it should reduce all print-

ing and administration costs. All of the societies maintain some sort of public activity. The Historical Association, and (since the date of this report), the Political Association, have moved in the same direction.

The net expenditure varies from $30,000 for the Academy to $4,000 for the Political Science Association. The measure of the effectiveness of these societies is however not the sums spent but the value of the work done. The Academy, with $30,000 a year to spend, ought certainly to be lending a far greater aid to the problems of the general subject of history, government and economics than the three other societies with their combined income of $27,000. How far that is the case must be left to the decision of those cognizant of the work of the four societies. One thing is certain, that none of the four societies furnishes a sufficiently detailed account; and that the report of the American Academy of Political and Social Science shows over $20,000 a year expended for publications as against $18,000 for the publications of the other three societies. The published accounts do not furnish a basis from which it is possible to find out why its cost per unit for carrying on and printing the publication should be twice as great as those of all the three sister societies doing the same kind of work. Here is an opportunity for a reform in corporate accounts.

ALBERT BUSHNELL HART

HARVARD UNIVERSITY

SPECIAL ARTICLES

EVIDENCE THAT SODIUM BELONGS TO A RADIOACTIVE SERIES OF ELEMENTS

BY the usual test for radioactivity, *i. e.*, the continued ionization of a gas independent of other physical conditions, sodium as an element does not display any activity that is definitely greater than that found in all matter. And the ionizing activity of ordinary matter is so slight that it can not be stated with definiteness whether or not it is of itself radioactive. But radioactivity implies a more fundamental change than that of emitting matter and energy continuously. It implies an atomic disintegration. If α particles are emitted the atoms go by leaps and bounds to new atoms of other properties, while if β and γ radiations are emitted the wearing away of the atoms must be just as certain, though no one has been able to conjecture by what steps the change might take place.

Campbell and Wood[1] examined the sodium compounds for ionizing radiations. Their apparatus would have detected an activity much less than that of potassium, which is only one thousandth that of uranium. No radiations could be measured. The fact that a given element does not give out a measurable ionizing radiation is not necessarily evidence that it is not radioactive. For example, we may note the case of radium *D*, which gives no measurable radiations. Yet it disintegrates to half value in about forty years. It is therefore known as a radioactive element. Further, helium as an element may be classed as a radioactive element, providing all helium is of radioactive origin, although of itself no ionizing radiations are emitted. It is sufficient that an element be of radioactive parentage. Thus sodium is a radioactive element if it can be shown that it disintegrates into other forms of matter or if it is the result of the disintegration of other forms of matter.

If sodium is a radioactive element we may at present look for other evidence than direct radiations. We shall inquire if in past geologic time sodium has accumulated radioactivity from other matter, or, on the other hand, if sodium has disappeared or disintegrated into other forms of matter.

THE EVIDENCE FROM GEOLOGY

Geophysics furnishes two distinct lines of evidence which favor the hypothesis that sodium belongs to a series of radioactive elements. The first is based on the age of the earth as determined by radioactive data and by the accumulation of sodium in the ocean. The second is based on the relative accumulation in the ocean of sodium compared to chlorine, taken in connection with the relative

[1] *Proc. Camb. Phil. Soc.*, 14, p. 15.

annual output of these two elements by the rivers.

Different authorities give the age to range between seventy and one hundred million years. On the other hand, the data of radioactivity require the age to be about ten times as great as the figures above noted. The principles of the radioactive method are based on the determination of the amounts of helium or lead associated with known quantities of uranium found in rocks of different epochs. The two principal assumptions that are involved are that during the age in question the amount of the uranium and its products which give rise to helium shall have remained constant and that the rate of production of helium shall have remained unchanged. Naturally these two assumptions can not be proved. It can only be said that there is no evidence that casts much suspicion on these. However, in all determinations by the radioactive method some error may accrue owing to a simultaneous deposition of uranium and lead and helium at the time of formation of the rock whose age is in question. As may seem clear later in this discussion, the magnitude of this error is probably not greater than the discrepancy between the age as determined by the accumulation of helium and by the accumulation of lead.

According to experiments by Rutherford and his colleagues one gram of uranium in equilibrium with its products gives 10.7×10^{-8} c.c. of helium per year. Now if we examine the rocks of the different geological epochs we find the rare gas helium enclosed in the rock wherever uranium is found, and further the older the rocks the greater is the amount of the helium associated with each gram of the uranium. Obviously, if we divide the total amount of helium per gram of uranium by the above constant, 10.7×10^{-8}, we obtain the number of years during which the uranium has been depositing helium, *i. e.*, the age of the rock containing the uranium. It may be mentioned that the diminution of the amount of uranium during the age in question is so small that it may be considered negligible in comparison with other errors.

Perhaps the greatest chance for error in the above method of calculation lies in the possible escape of helium from the rock containing the uranium. If so the age of the rock as calculated might be too small. The method would therefore set a minimum limit on the age of the earth.

But if we accept Boltwood's conclusion that the lead associated with uranium in rocks resulted from the radio-active disintegration of the uranium series of elements, and that one gram of uranium gives rise to 1.88×10^{-11} gram of lead per year, we have a check upon the results obtained based on the helium deposits. In general the lead deposits give a somewhat larger age for a given rock than do the helium deposits, which is what we should expect if the helium may escape or if lead might have been deposited with the uranium originally.

Using the method outlined above, Rutherford, in 1906, found the age of a sample of fergusonite to be 240,000,000 years. This was deduced as outlined from the fact that 1.81 c.c. of helium was taken from one gram of the mineral known to contain about 7 per cent. uranium.

Strutt by the same method found two rocks of the Archæan period from Quebec to be 222 and 715 million years old, and two of the same kind from Norway to be 213 and 449 million years old. He also found the average minimum value for hæmatite of the Eocene period to be 31 million years, the same for the carboniferous period limestone to be 150 million, while for the Archæan age the average was 710 million years.

Holmes[2] using as a basis the ratio of the lead to the uranium in the rocks found the values given in the following table:

Period	Age	
Carboniferous	340,000,000	years.
Devonian	370,000,000.	
Pre-Carboniferous	410,000,000.	
Silurian	430,000,000.	
Pre-Cambrian	1,025,000,000	Sweden.
	1,310,000,000	U. S.
	1,640,000,000	Ceylon.

[2] *Roy. Soc. Proc.*, Ser. *A*, 85, p. 248, 1911.

The above results show that the earth in its present form must be many times a hundred million years old.

However, if we take the evidence as based on the result that is obtained by dividing the total amount of sodium in the ocean by the annual additions of all the rivers of the globe, we find that the age of the ocean can not be more than one hundred million years. Two of the most eminent geologists, F. W. Clarke[3] and J. Joly,[4] think 70,000,000 years to be more nearly the correct age. It seems to me that these estimations were not made without due consideration of the largest sources of error. According to Clarke the saline matter of the ocean if segregated would occupy nearly five million cubic miles, a quantity compared to which all beds of rock salt become insignificant. He also considered the salt of marine origin in sedimentary rocks and he figured that a correction of not more than one per cent. was necessary to allow for sodium disseminated in this way. If there is error due to unequal annual additions by the rivers, Becker[5] argues that it is altogether in favor of making the age of the earth yet smaller rather than larger, perhaps between 50 and 70 million years. There is therefore a discrepancy between the age of the earth as deduced by the two methods. Joly in the *Philosophical Magazine* for September, 1911, favors the view that the radioactive constants are in error, because these constants have not been taken from data extending over a sufficiently long time and under proper circumstances free from doubtful assumptions.

I wish to suggest that there is another explanation of the discrepancy that requires no distrust of the radioactive constants as they have been experimentally determined. In fact, the explanation is merely an extension of our knowledge in radioactivity. The discrepancy may be made to disappear if sodium is supposed to belong to a series of radioactive elements. If we accept the present data of radioactivity as authoritative, then it must be admitted that there is not enough sodium in the ocean. Perhaps during geologic time elements of higher atomic weight may have been disintegrating into sodium, and therefore the annual output of the rivers now is not the same as the average annual output for all time in the past. That is, the sodium over the land has been increasing by radioactive production while sodium in the ocean has been increasing almost entirely by the annual river supply. This would necessitate that the parent of sodium should commonly exist in relatively insoluble compounds. Otherwise we should have had sodium produced radioactively also in the ocean, and perhaps sodium deposits in the bottom of the ocean. The above fact should give us some clue as to the parentage of sodium, if our whole argument is not faulty. Obviously those elements that have been deposited in the ocean bed in appreciable quantities are eliminated.

The second way for explaining the small sodium content of the ocean is to assume that the sodium in the ocean has disintegrated into other elements. The theory of radioactivity as it now stands, however, requires that the rate of decay of an element shall not be altered by its physical state or surroundings. Then it is highly probable that the sodium in the ocean has not decayed faster than has the sodium on the land, and therefore any diminished quantity of sodium on the ocean would have been offset by a diminished annual addition of the rivers. But the quantity of sodium carried by the rivers is not known to vary greatly with the amount in the earth's crust. It seems then that this second explanation is within the limits of possibility.

The simplest explanation and one which requires no apologies or additional assumptions is based on the supposition that the sodium on the land has been increasing by virtue of the existence of the parent of sodium there and the non-existence of the parent in the ocean or the ocean bed. Perhaps there would be less chance for error if it were stated that the pres-

[3] Bulletin 491, U. S. Geol. Surv.

[4] *Phil. Mag.*, Ser. 6, 22, p. 357, 1911.

[5] *Quart. Journ. Sci.*, May, 1909.

ence of sodium must have existed more abundantly on the land. This is along the lines of recent progress, and it is particularly favored because it is the only apparently reasonable explanation for another discrepancy arising from the facts of geochemistry. This additional discrepancy is involved in the succeeding paragraphs.

FURTHER EVIDENCE FROM GEOLOGY INDICATING THAT SODIUM BELONGS TO A SERIES OF RADIOACTIVE ELEMENTS

There are other elements carried to the ocean by the rivers in a soluble state, which indicate quite a different age of the earth, and consequently favor the radioactivity of sodium. Only those elements that are not deposited in the ocean bed or otherwise removed from the ocean water may be considered for reliable information. Clarke in his "Geochemistry," second edition, p. 125, gives the following facts; the figures in the last column are my own deductions however.

	Annual Output from Rivers, Metric Tons	Metric Tons in the Ocean	Age of the Ocean
Chlorine ...	$155,350 \times 10^3$	$25,536 \times 10^{12}$	160×10^6
Sodium......	$158,357 \times 10^3$	$14,136 \times 10^{12}$	89×10^6

The geologists do not believe that the rivers carried any less chlorine or sodium formerly than they do now. In fact, Becker thinks that they must have carried more previously than they do now. But supposing they did carry less sodium in previous ages (in order to explain away the discrepancies on the age of the earth), there is no obvious reason why they should not also have carried proportionately less chlorine. We may, therefore, for checking purposes, say nothing concerning the annual river output further than it should have varied alike with sodium and chlorine. On this assumption the above figures show that there is not as much sodium in the ocean as there should be. Disregarding the radioactivity data for the uranium series of elements altogether, we see that the above evidence favors radioactivity of sodium. Clarke goes on further to state:

> We can understand the accumulation of sodium in the ocean and some of the losses are accounted for, but the great excess of chlorine in sea water is not easily explained. In average sea water sodium is largely in excess of chlorine; in the ocean the opposite is true, and we can not help asking whence the halogen element was derived. Here we enter the field of speculation and the evidence upon which we can base an opinion is scanty indeed.

This excess of chlorine can be accounted for by the same hypothesis that was used to explain the discrepancies in the age of the earth in the early part of the paper, viz., sodium has either accumulated radioactively on the land or disintegrated in the ocean, while for chlorine either these changes have not taken place or else they have gone on at a rate much slower than that in sodium.

From the foregoing, it is obvious that, whether we consider the radioactive data or only the data of geochemistry, either method of approach makes it convenient to assume that sodium belongs to a radioactive series of elements. There has not been to my knowledge any satisfactory explanation for the discrepancies to which attention is called in this paper, either singly or in common. However, it may be noted that the age of the earth as calculated from the chlorine content of the ocean is yet much smaller than that given by the radioactive data, but I do not believe this to be seriously against the argument as presented. It may be that chlorine is accumulating slower than sodium on the land, or perhaps all matter is radioactive in varying degrees, but that is beyond the argument here presented.

It seems worth while to inquire further what elements of atomic weight greater than that of sodium are found more abundantly on land than in the ocean. If our hypothesis is correct we might obtain a list of elements one or more of which should give rise to sodium. And a further study of this list, both in nature and in the laboratory, might reveal the parent of sodium. Of course if the parent of sodium had long ago become extinct this search would be futile.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SECTION A—MATHEMATICS AND ASTRONOMY

As both mathematics and astronomy were represented by national societies meeting in affiliation with the association, Section A confined itself to an afternoon session, which was held on Tuesday, December 31. Professor E. B. Van Vleck, of Wisconsin University, presided during this joint meeting of Sections A and B, the American Mathematical Society (including the Chicago Section), the American Physical Society and the Astronomical and Astrophysical Society of America. The meeting was attended by more than two hundred and fifty members of the association and affiliated societies.

In the absence of the retiring vice-president and chairman of Section A, Professor E. B. Frost, director of Yerkes Observatory, his address, entitled "The spectroscopic determination of stellar velocities, considered practically," was read by Professor J. A. Parkhurst. This address will be published in *Popular Astronomy*. The retiring vice-president and chairman of Section B, Professor R. A. Millikan, University of Chicago, presented an address entitled "On unitary theories in physics," which will appear in SCIENCE.

In addition to these two addresses the following four papers were presented during the session of Section A:

"Henri Poincaré as a mathematical physicist," Professor A. G. Webster, Clark University.

"Some general aspects of modern geometry," Professor E. J. Wilczynski, University of Chicago.

"Cosmical magnetic fields," Dr. L. A. Bauer, director of the Department of Terrestrial Magnetism, Carnegie Institution of Washington.

"Preliminary note on an attempt to detect the general magnetic field of the sun," Professor G. E. Hale, director of Mt. Wilson Observatory.

In the absence of Professor Hale his paper was presented by Dr. Bauer. The others were presented by their respective authors. Professor Webster's paper will appear in SCIENCE. Brief abstracts of the other three are as follows:

After discussing briefly the general relations between analysis and geometry, Professor Wilczynski considered the notion of a space of n-dimensions and showed how wide is the applicability of this idea even if we confine our attention to ordinary space, provided a suitable geometric form is chosen as generating element. His developments culminated in a general theorem which, as he claims, represents a fundamental unifying principle of geometry. This theorem may be stated as follows: The projective geometry of any analytic k-spread in a space of n-dimensions is equivalent to the theory of the invariants and covariants of a certain associated completely integrable system of partial differential equations. The paper will appear in the *Bulletin of the American Mathematical Society*.

Dr. Bauer made application of the results of his investigations on the origin of the earth's magnetic field, presented at the Pittsburgh meeting of the Astronomical and Astrophysical Society of America, and Section B of the association at the Cleveland meeting, to the possible magnetic fields of the sun and planetary bodies. A new mathematical method of analysis of the earth's magnetic field was briefly sketched. The paper will appear in *Terrestrial Magnetism and Atmospheric Electricity*, 1913.

Although some definite results have been obtained by Professor Hale, further observations will be required to prove conclusively whether or not the effects found are due to the sun's magnetic field. However, the present observations indicate that the north and south poles of the sun agree in magnetic polarity with those of the earth. As far as the strength of the field is concerned, a knowledge of the Zeeman effect for the lines in question is necessary to determine this. It happens that all of these lines are too faint in the spark to appear on the photographs, but another effort is being made to observe their behavior in the magnetic field.

The investigation is being pushed forward as rapidly as possible, in view of the quiet condition of the sun, since the appearance of sunspots, with their very powerful magnetic fields, will tend to introduce troublesome perturbations. The paper appeared in *Terrestrial Magnetism and Atmospheric Electricity*, Vol. XVII.

The following members of Section A were elected as fellows of the association: S. B. Barret, Harriet W. Bigelow, A. E. Burton, A. E. Douglass, S. Einarson, F. Ellerman, E. A. Fath, J. C. Hamilton, E. S. Haynes, W. A. Hurwitz, E. S. King, C. O. Lampland, F. P. Leavenworth, O. J. Lee, A. O. Leuschner, J. Lipke, C. P. Olivier, G. H. Peters, W. F. Rigge, D. Rines, E. Smith, T. Stephen, H. T. Stetson.

The section elected Dr. J. A. Brashear member of the council, Professor C. J. Fields member of

the sectional committee for five years and Professor T. F. Focke member of the general committee. On recommendation of the sectional committee Professor Frank Schlesinger, director of the Allegheny Observatory, was elected vice-president and chairman of the section, and Professor F. R. Moulton, University of Chicago, was elected secretary for five years.

G. A. MILLER,
Secretary of Section A

SOCIETIES AND ACADEMIES

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

A SPECIAL meeting of the society was held December 3, 1912, at 4:30 P.M., in the New Museum Building, Mr. Stetson, the president, in the chair.

Mr. Wm. H. Babcock read a paper on "The Islands of Antillia," illustrated by lantern slide maps, taking the title of his paper from Peter Martyr's "Decades of the New World," where that author, in view of "the cosmographers," states that he believes these islands were what his contemporary, Columbus, had discovered. Peter Martyr's own sketch map of 1511 was exhibited, showing Florida as one of them under the name of Beimeni: also the maps of Beccaria, Bianco, Pareto and Benincasa, from 1435 to 1482, who may be among "the cosmographers" referred to. They show a group of four large islands roughly corresponding in size, arrangement and other respects with Cuba, Jamaica, Florida or Beimeni and Andros of the Bahamas, and bear on Beccaria's map the names Antillia, Reylla, Salvagio and Insula in Mar (Opposite Island or Island out Before, King Island, Savage Island and Island in the Sea). These are nearly as far west of the Azores as the latter are west of Europe and in such a location must be either the creatures of mere fancy or appurtenances of America. But it is not likely that mere guess-work could produce the remarkable correspondences of these great map islands with the reality, such an island group being altogether unique in the Atlantic.

Behaim's globe of 1492 contains an inscription to the effect that a Spanish vessel visited Antillia in 1414, more vaguely endorsed by another on the map of Ruysch (1508) which credits the Spaniards with finding Antillia long ago. That something of the kind happened in the first quarter of the fifteenth century may be inferred from the fact that Beccaria (1535) names the group collectively "The Newly Reported Islands," most likely borrowing this title legend from his earlier map of 1426, although the fourteenth-century maps had contained no suggestion of Antillia and her consorts.

The other fifteenth-century maps named corroborate Beccaria, being very consistent in outline and arrangement so far as they go, although two of them give but three islands and Bianco shows only Antillia and a part of Salvagio, which he calls La Man de Satanaxio, but this last seems to be a case of mutilation. However, the Laon globe of 1493 shows only these two main (rectangular) islands.

A current map showed how naturally any craft entering and continuing in the great-sea-current which sweeps from the Azores and the other eastern islands westward to the Antilles would be carried to Cuba and her neighbors.

The Catalan map of 1375 and the Pizigani map of 1367 with its picture of St. Brandan blessing his Fortunate Islands of Porto Santo and Madeira, and the figures of a dragon and a dentapod, each carrying off a seaman from his ship as a warning against westward exploration, were also exhibited. They show the circular island of Brazil west of Ireland and the more southerly crescent-form Man or Brazir, both being important and persistent legendary islands: and the Catalan map in particular shows all the Azores approximately in their real grouping; but neither of them presents anything like the Islands of Antillia.

Dr. Philip Newton read a paper on the Negritoes of the Philippines, estimating their total number (full bloods) at 5,000, though by counting mixed-blood tribes and individuals the estimate is sometimes carried up to 25,000. They are distributed through numerous islands, though not reported from Mindoro. The greater number are on Luzon. There is no difference in them, except as their blood is mingled with that of neighboring races. They are not fishermen, but hunt and gather natural products, using in some districts poisoned arrows, the symptoms of poisoning being like those of strychnine. Their houses are made of upright poles connected by horizontal poles having cross pieces and leaf thatching. They are buried under or near these homes. They rarely bathe and their clothes (which are breech-clouts or aprons) are apparently never washed. Usually these are of cloth obtained in trade, but in some islands, for example Palawan, bark is used. Negritoes do not regularly practise agriculture, but will sometimes plant rice—and perhaps move away before it ripens. A skin disease is the most

prevalent among them, but malaria also prevails. Three incipient cases of tuberculosis were noted. Some other diseases are derived from their neighbors.

W. H. Babcock,
Secretary

THE HELMINTHOLOGICAL SOCIETY OF WASHINGTON

The twelfth regular meeting of the Helminthological Society of Washington was held at Mr. Crawley's residence, November 21, 1912, Mr. Crawley acting as host and chairman.

The secretary presented a paper by Dr. B. H. Ransom entitled "An Important Newly Recognized Parasitic Disease of Sheep." Less than a year ago reports began to come in from inspectors in packing establishments where federal meat inspection is maintained, that a considerable number of sheep were found, on post-mortem inspection, to be infested with tapeworm cysts. These were located in the musculature, and as the infested meat had to be condemned it was a matter of considerable economic importance. German authorities have referred an armed cysticercus in the meat of sheep to *Cysticercus cellulosæ* and it was first thought that this was the case here. But the fact that from one to four per cent. of the sheep killed at some establishments were infested indicates that this was not the case, as *Cysticercus cellulosæ* is very rare in its normal host, the hog, in this country. Microscopic study showed that the form found in sheep was similar to *Cysticercus cellulosæ*, but nevertheless distinct. It seemed further unlikely that the adult tapeworm should be a human tapeworm, as it ought to be reasonably common and to have been recorded before this. The logical host of the adult worm was held to be the dog, and in this connection it may be noted that French investigators of the cysticercus in the meat of sheep have held it to be an aberrant *Cysticercus tenuicollis*, the hooks of the two forms being very similar.

The matter was settled by feeding cysticerci from the meat of sheep to five dogs, and *Cysticercus tenuicollis* to two dogs. All of the dogs developed tapeworms, but those of the five dogs were distinct from those of the two fed *Cysticercus tenuicollis*. Six sheep were then fed tapeworm eggs from the tapeworms of the five dogs, and two were fed eggs of the *Tænia hydatigena* produced in the two dogs from the feedings of *Cysticercus tenuicollis*. One sheep was kept as a check. All sheep fed with eggs from the tapeworms of the five dogs receiving muscle cysts developed cysts in the muscles, but no *Cysticercus tenuicollis;* both sheep fed eggs of *Tænia hydatigena* developed *Cysticercus tenuicollis*, but no cysts in the muscles. The check sheep and other sheep of the same lot had no cysticerci of any sort.

The new cysticercus is a source of considerable loss to the western sheep man and warrants careful prophylactic measures, such as the destruction of the carcasses of dead sheep and the employment of vermifuge treatment for dogs.

Mr. Foster presented a paper entitled "Some Atypical Forms of the Eggs of *Ascaris lumbricoides.*" In examining feces or in dissecting ascarids, certain atypical shapes of ascarid eggs are not uncommonly met with. Some of these eggs are very much longer and narrower than the normal eggs, the length, up to 107 micra, being well outside of the limits given in texts. Sometimes nearly all the eggs in an ascarid will be of this sort. Another atypical form has no trace of the usual external mammilated albuminous covering, although segmentation shows that fertilization has occurred. The third form is the unfertilized egg, the unsegmented central embryonic mass filling the entire shell. A recognition of these forms is important in microscopic examination of feces.

The secretary presented a paper by M. C. Hall and J. T. Muir entitled "A Critical Study of a Case of Myiasis due to *Eristalis.*" A five-year-old boy in Colorado Springs, Colo., during the summer of 1912, showed a complex of nervous and digestive disturbances, with emaciation due apparently to excessive vomiting. The case was diagnosed as worm infestation. Immediately after defecation following the administration of a vermifuge, an active larva of *Eristalis* was found in the slop jar. A critical examination of the possibility of myiasis due to "rat-tailed larvæ," and of the circumstances in the case discussed, more especially the prompt recovery of the patient, leads the authors to the conclusion that this is probably a genuine case of myiasis. The evidence is more complete and detailed than in any other published case dealing with myiasis due to these larvæ, the other cases being given in detail in the paper. Additional unpublished cases from the U. S. Bureau of Animal Industry and the U. S. Bureau of Entomology were noted. There appear to have been only seven published cases of myiasis credited to "rat-tailed larvæ."

Maurice C. Hall,
Secretary